# IMPROVEMENTS TO THE HEAVY OIL MINI-PLANT RESEARCH FACILITY

FINAL REPORT

BY

KILBORN ENERGY INC.

Work on this project was conducted under the auspices of the Department of Energy, Mines and Resources

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EMR SCIENTIFIC AUTHORITY: Mr. Z. Potoczny

11 pp

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CONTRACT 04SQ.23440-6-9194

# IMPROVEMENTS TO THE HEAVY OIL MINI-PLANT RESEARCH FACILITY DEVON ALBERTA

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## 1.0 EXECUTIVE SUMMARY

Modifications to the electrical and ventilation systems to satisfy the needs of the Heavy Oil Mini-Plant Research Facility were completed consistant with the scope of work and estimated costs defined in the Contract.

## 2.0 INTRODUCTION

The existing maintenance building at the Devon Research Centre has been converted to a Heavy Oil Mini-Plant Research Facility. Kilborn Energy Inc. were engaged to replace the electrical components in the test area with electrical components suitable for a Class I Group D Division 1 electrical area classification. General purpose switchgear, MCC's and control equipment were located in a separate room within the research test facility. Ventilation air from an external air supply unit was provided for the electrical room and general test facility area.

The heavy oil mini-plant test equipment was supplied and installed by others under a separate Contract to Energy Mines and Resources.

## 3.0 TECHNICAL DISCUSSIONS

Modifications to the electrical and ventilation systems at the Devon Research Centre involved the following changes;

- Removal of existing gas fired unit heaters.

- Removal of general purpose electrical components in the test area and replace vent with electrical components suitable for electrical area classification noted on the drawings.

- Construction of a separate electrical/control room to house general purpose switchgear, MCC and control equipment. The electrical/control room will be presurized by the ventilation fan located exterior to the building. A room air conditioning unit has been provided for operator comfort.

- Installation of a new direct fired air supply unit (located exterior to the building) to provide approximately 5 air changes/hr and provide pressurization air for the electrical/control room.

- Installation of two roof mounted exhaust fans capable of removing approximately 5 air changes/hr under normal operation and 10 air changes/hr should a hydrocarbon spill cause the hydrocarbon detector to be activated.

- Installation of two glycol/water unit heaters sized to accommodate normal building heat losses.

- Provision of two hydrocarbon detectors one located in the test facility area and one located in the electrical/control room. The detector located in the test facility area is designed to automatically increase the ventilation air rate by:
  a) opening the damper on the inlet to the air supply unit
  b) activate the second exhaust fan.

## 3.0 TECHNICAL DISCUSSIONS (cont'd)

The detector located in the electrical/control room is designed to automatically trip the power supply to the building.

In the event of a power outage the air supply unit will be powered from the general plant emergency generator. This design feature will ensure purge air for the electrical/control room is maintained during an extended power outage.

Another safety feature incorporated in the design to guard against mechanical or electrical failure of the air supply unit is the provision of an air proving switch which will automatically trip the power supply to the building.

Procedures for the operation and maintenance of the gas fired air supply unit are described in detail by the equipment manufacturer. This procedure will be provided to the Scientific Authority separate to this report.

The design criteria and operation of the electrical systems are as follows:

Due to unique nature of the building facility design (i.e. Electrical room located adjacent to Class I Group D, Div 1 Area) the following procedures shall be followed to ensure the safety of personnel and equipment at the mini-plant facility. Electrical single line and schematic drawing No. 402, sheet 2 shall be used in conjunction with these procedures.

## 3.0 TECHNICAL DISCUSSIONS (cont'd)

### 1.0 Initial Startup

1.1 Close the 15 amp 3 pole, 600 volts breaker in emergency panel EM, located in main electrical room of Devon Coal Research Centre.

1.2 Start the Air Make-up unit at Mini-plant Test Facility. This will start pressurizing the electrical room at test facility.

1.3 Close the 600V, 3 pole, fused disconnect switch at test facility and 600V, 3 pole circuit breaker in main building electrical room. This would provide the normal power to test facility. Exhaust fan No. 1 shall be started immediately. This would provide the safe condition to start the mini-plant.

### 2.0 Normal Operation

During normal operation following events can cause maintenance and operations to evacuate the test facility.

2.1 If hydrocarbons leak due to process equipment failure in the mini-plant area, hydrocarbon leak detection system will provide visual and audible alarms and a second exhuast fan No. 2 will automatically start. As long as alarm condition exist personnel shall not enter the building and may consider shutting the process to analyze the situation.

## 3.0 TECHNICAL DISCUSSIONS (cont'd)

### 3.0 Loss of Pressurized Air to Electrical Room

3.1 Loss of pressurized air to electrical room at Mini-plant Test Facility (longer than 35 seconds, field adjustable timer) will trip the circuit breaker in main electrical room and initiate the local visible and audible alarms, as long as emergency power is available. The 35 second (adjustable) time delay is introduced in the control circuit to ensure that the emergency generator comes into operation on loss of normal power.

### 4.0 Restoration of Power After Loss of Air

4.1 As long as emergency power is available, the loss of air is due to primarily mechanical failure of air flow switch or fan belt or blockage in duct work or control circuit wiring failure.

4.2 Shutdown the Mini-plant process and diagonize and correct the problem.

4.3 Ensure audible/visible alarms are off prior to closing the circuit breaker in main electrical room to restore the normal power to Test Facility.

### 5.0 Loss of Air and Loss of Emergency Power

5.1 Restore power supply to air makeup unit.

5.2 Qualified people should open all doors of test facility until such time building power is restored.

## 3.0 TECHNICAL DISCUSSIONS (cont'd)

5.3 Follow steps 1.1 to 1.3.

5.4 Close all building doors once the plant is in operation.

The detailed construction drawings and specifications have been bound and assembled as Appendix "A" to this report.

## 3.0 TECHNICAL DISCUSSIONS (cont'd)

The detailed construction drawings and specifications have been bound and assembled as Appendix "A" to this report.

# IMPROVEMENTS TO THE HEAVY OIL MINI-PLANT RESEARCH FACILITY

## APPENDIX "A"

## CONSTRUCTION SPECIFICATIONS AND DRAWINGS

by KILBORN ENERGY INC.

113 pp + figs. DSS FILE #04SO.23440-6-9194

# IMPROVEMENTS TO THE HEAVY OIL
MINI-PLANT RESEARCH FACILITY

## APPENDIX "A"
CONSTRUCTION SPECIFICATIONS AND DRAWINGS

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Exhinit "B" - Drawings and Specifications

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| 401 | Area Classification, Lighting and Power Plan | 1 |
| 402 | Single Line and Schematic Diagrams | 1 |
| 301 | HVAC Layout, Control Room Plans, Elevations, Sections and Details | 0 |

SECTION: 4
JOB NO.: A149-15
AGMT NO.:A149-15-SC-001

# EXHIBIT "A"

# SCOPE OF WORK

# ARCHITECTURAL

IMPROVEMENTS TO THE HEAVY OIL

MINI-PLANT RESEARCH FACILITY
DEVON ALBERTA

## 1.0 Scope Of Work

1.1 The work shall include, but shall not be necessarily limited to, the furnishing of all labour, materials, tools, equipment and services for and incidental to the following catagories of work as listed herein and shown on the drawings.

### 1.2 Architectural Work

a) The supply and installation of new concrete block walls including all doors, windows, embedded metals, rebar and hardware.

b) Build in openings in the walls and roof for piping, electrical conduit and ductwork.

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SECTION: 5
JOB NO.: A149-15
AGMT NO.:A149-15-SC-001

# EXHIBIT "B"

# DRAWINGS AND SPECIFICATIONS

IMPROVEMENTS TO THE HEAVY OIL

MINI-PLANT RESEARCH FACILITY
DEVON ALBERTA

## 1.0 Drawings and Specifications

1.1 The Subcontractor shall comply with all applicable local, provincial and federal laws, codes, orders and regulations.

1.2 The work shall be performed in accordance with the standards and practices contained in the following specifications and drawings.

| Section No. | Title |
|---|---|
| 01300 | Submittals |
| 04200 | Masonry |
| 05500 | Custom Steel Fabricators |
| 08110 | Steel Hollow Metal Frames |
| 08115 | Hollow Metal Doors |
| 08700 | Hardware |
| 08800 | Glass and Galzing |

| Drawing No. | Title | Rev. No. |
|---|---|---|
| 101, 901 | Control Room Plans, Elevation, Sections and Details | 0 |

## SUBMITTALS

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1. SHOP DRAWINGS

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Subcontractor to illustrate details of a portion of the Work.

.2 The Subcontractor shall arrange for the preparation of clearly identified shop drawings as called for by the Contract Documents and for such other items as the Contractor may reasonably request.

.3 Shop drawings shall be prepared in accordance with the Manual on Metric Building Drawings Practice published by the National Research Council of Canada. Conformance with sections 4.1 to 4.9 of the manual is not mandatory.

.4 Prior to submission to the Contractor, the Subcontractor shall review all shop drawings. By this review, the Subcontractor certifies that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and certifies that he has checked and coordinated each Shop Drawing with the requirements of the Work and of the Contract Documents. The Subcontractor's review of each shop drawing shall be indicated by stamp, date and signature of a responsible person.

.5 Not less than two (2) of shop drawings shall be submitted through the Subcontractor to the Contractor. In addition, the Subcontractors, if he deems necessary, shall arrange with his Suppliers for any additional copies of shop drawings that he (the Subcontractor) shall require. The shop drawings, when submitted to the Contractor, shall bear the date stamp of, and be checked by, the Subcontractor.

.6 When submitting the shop drawings the Subcontractor shall notify the Contractor in writing, on the shop drawings, of any changes that he has made, from that which has been called for in the drawings and specifications. Failure of the Subcontractor to check or have corrected or indicate any change and variation, in submitting shop drawings, will result in their return to the Subcontractor without consideration or checking by the Contractor.

.7 If the shop drawings are rejected by the Contractor he will return one (1) copy to the Subcontractor, and retain one (1) copy. All other copies shall be destroyed.

.8 The Subcontractor shall resubmit not less than two (2) copies plus any additional copies, as before described, of the revised shop drawings.

.9 After review, the Contractor will retain one (1) copy and return the remaining copy to the Subcontractor, who shall then distribute the shop drawings to all parties concerned.

.10 The Contractor's review of such drawings or of the revised drawings shall not relieve the Subcontractor from respsonsibility for errors or for changes made from the Contractor's drawings or specifications.

## 2. SAMPLES

.1 The Subcontractor shall submit for the Contractor's review, such standard manufacturers' samples as the Contractor may reasonably require. Samples shall be labelled as to origin and intended use in the Work.

.2 The Subcontractor shall provide samples of special material assemblies, or components when so specified.

## 3. OPERATING/MAINTENANCE MANUALS

.1 Provide Contractor with 3 copies of Operating and Maintenance Data, as called for in the Contract Documents, made up as follows:

    .1 Bind data in vinyl hard cover, 3 ring, extention type, loose leaf binder for 215 x 380 mm size paper.

    .2 Enclose title sheet, labelled "Operating and Maintenance Data Manual", project name, date, and list of contents.

    .3 Organize contents into applicable sections of work to parallel project specifications section breakdown. Identify each section with tabs of laminated mylar plastic. (See Section 15010 for specific Mechanical colored tab requirements).

.2 Include the following information plus data specified:

  .1 Maintenance instructions for finished surfaces and materials.

  .2 Copy of hardware and paint schedules.

  .3 Names, address, and phone numbers of Sub Trades and Suppliers.

  .4 Guarantees, warranties, and bonds showing:

    .1 Name and address of project.

    .2 Warranty/Guarantee/Bond commencement date and duration.

    .3 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.

    .4 Additional material/equipment used in project listed under various sections showing name of manufacturer and source of supply.

.3 Neatly type lists and notes. Use clear drawings, diagrams, or manufacturer's literature.

.4 Include one complete set of reviewed shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.

.5 Submit Operating and Maintenance Manuals before or with application for Interim Acceptance.

END OF SECTION

## 1 GENERAL

### 1.1 Description

1.1.1 Work Included

- Unit masonry complete.
- Masonry and lintels, sills, coping and other masonry appurtenances to be built in the masonry.
- Bracing, forming, shoring, temporary scaffolding and planks, temporary protection, including wind bracing of masonry walls, required in conjunction with and in course of constructing masonry and not provided elsewhere.
- Furnishing test specimens and samples of materials as may be required, such as sampling of masonry units.
- Building into masonry all bolts, anchors, reinforcement, nailing blocks, inserts, window and door frames, vents, conduits, pipe, etc. as may be required to be built in, including such items furnished and located under other Sections.

### 1.2 Quality Assurance

1.2.1 Qualifications of Installers

For the actual cutting and placing of masonry units, employ only skilled journeyman masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.

In acceptance or rejection of installed masonry, no allowance will be made for lack of skill on the part of the workmen.

One skilled journeyman, who shall personally direct the execution of this portion of the Work, shall be present at all times during the execution of the Work of this Section.

1.2.2 Codes and Standards

CAN3-A5-M77
Portland Cement

CSA A82,43-1950 (R1971)
Hydrated Lime for Masonry Purposes

CSA A82.56-M1976
Aggregate for Masonry Mortar

CSA A165-M Series 1977
CSA Standards on Concrete Masonry Units

CSA A179M-1976
Mortar and Grout for Unit Masonry

CAN3-S304 M78
Masonry Design and Construction for Buildings

Maintain a copy of CAN3-S304 on site.

CSA G30.12-M1977
Billet Steel Bars for Concrete

1.2.3 Tolerances

Article 3.14 of CSA S304.

1.2.4 Shop Drawings

1.3 Product Handling, Delivery and Storage

1.3.1 General

- Keep all materials clean and dry. Protect from weather and soil. Clearly identify materials.

1.3.2 Replacements

Replace exposed units which become stained or chipped, and materials which are affected by inadequate protection.

1.3.3 Storage

Maintain separate storage areas for each type of masonry unit.

Stack masonry units to avoid chipping. Protect masonry units against wetting prior to use. Such units and precast concrete lintels, sills, and coping units shall be free from soil, ice and frost when laid in the wall.

## 1.4 Job Conditions

1.4.1 Environmental Requirements

To requirements of Article 3.15 of CSA S304.

1.4.2 Protection

Protect masonry corners from damage by erection of 38 mm x 140 mm buffers 1200 mm above floor, securely braced. Protect finished walls from damage.

Brace freestanding masonry walls as required by referenced standards and as directed until permanent construction provides adequate support.'

## 2. PRODUCTS

## 2.1 Materials

2.1.1 Load Bearing and Non-Load Bearing Hollow Block

Two core lightweight blocks to CSA A165.1. Nominal sizes 100 x 400, 150 x 400, and 200 x 400. Plain type and smooth faced with 1 (10 mm) vertical V-Groove scoring per block. See architectural drawings.

2.1.2 Special Structural Units

Special units are used where required for bond beams and lintels. For vertical internal exposed arrises 25 mm radius bullnosed units. Use corner blocks at control joints.

2.1.3 Mortar

Type 'S' mortar mixed in accordance with CSA A179-M1976 "Mortar and Grout for Unit Masonry".

Proportions by Volume:
1 part normal cement
1/2 part hydrated lime
4-1/2 parts sand

Sand is to satisfy CSA A82.56-M1976 "Aggregate for Masonry Mortar".

2.1.4 Grout

Use coarse grout to construct bond beams and lintel beams. Mix grout in accordance with CSA A179M-1976 "Mortar and Grout for Unit Masonry".

Proportions by Volume:

1 part normal cement
1/10 part hydrated lime
2-1/4 parts fine aggregate
1-1/2 parts sand

Sand is to satisfy CSA A82.56-M1976 "Aggregate for Masonry Mortar".

2.1.5 Fire-Resistance Rated Units

Units shall produce fire resistance required as indicated on Drawings or elsewhere in Specifications.

2.1.6 Special Shapes

Of ordinary available types such as bullnose units, header units, jamb units, etc., as may be required to complete the Work as indicated on the Drawings.

2.1.7 Steel Reinforcement

- Horizontal reinforcing to be 'Durowall' standard, hot dipped galvanized diagonal wire reinforcing confirming to ASTM A153. Use 3.66 mm thick reinforcing for chords and diagonals.

Vertical wall reinforcing to conform to CSA G30.12M, Grade 400.

## 2.2 Fabrication

### 2.2.1 Concrete Masonry Lintels

Fabricate concrete masonry lintels, sills, and coping from units of load-bearing grade of size required and of approved type and design. Unless otherwise indicate or approved, build in place. Reinforce lintels as indicated or approved and fill cavities containing reinforcement solidly with coarse grout.

## 3 EXECUTION

## 3.1 Preparation

### 3.1.1 General

Establish all lines, levels, and coursing and protect from disturbance. Co-ordinate all work of this Section with others, such as field welding of anchors to steel work and placing of dowel bars in concrete beams. Prepare all items to be built in, either supplied and installed by others or installed under this Section, as Work proceeds.

### 3.1.2 Inspection

Exposed faces of concrete units or faces of units to receive paint must be smooth, of uniform texture, and free of spalled or broken edges, corners, or other defects detrimental to appearance.

### 3.1.3 Cold Weather

If ice or snow has inadvertently formed on masonry bed, dry by application of heat. Apply heat carefully until top surface of masonry is dry to touch.

Remove sections of masonry deemed frozen and damaged before continuing construction of that section.

Use only dry masonry units. Do not lay wet or frozen units.

## 3.2 Installation

### 3.2.1 General

Install in accordance with requirements of CSA S304.

Distribute exposed masonry of varying colours, textures and tones over wall areas to produce a homogeneous blend. Discard units which are too contrasting in appearance, or with broken edges or corners.

Align vertical cells to be reinforced and filled to provide a continuous unobstructed opening of dimensions indicated, but in no case less than 50 mm x 75 mm. Fill all corners, intersections, and beside all openings.

Where non-load-bearing partitions are extended to underside of floor or roof deck or structure system, stop masonry short to allow for live load deflection. Fill gap with joint-backing material and caulk with approved type of sealant.

Maintain a 5 mm caulking gap between blockwork and all other abutting material with wood blocking.

Rub down exposed external corners of block partitions with carborundum stone to 3 mm radius.

### 3.2.2 Cutting and Fitting

All cutting and fitting of masonry, including that required to accommodate the work of other Sections, shall be done by masonry mechanics with masonry saws.

Obtain the approval of the Contractor before cutting any part or area which may, in his opinion, impair appearance or strength of the work.

### 3.2.3 Metal Door Frames

Solidly fill spaces around metal door frames and other built-in items with mortar.

### 3.2.4 Joint Type

- Concaved - firmly pointed and compacted with V-Groove bar tool to match block scoring.

All joints shall be of uniform thickness, in straight lines.

### 3.2.5 Horizontal and Vertical Face Joints

Horizontal and vertical face joints shall be 10 mm thick unless otherwise indicated. Shove vertical joints tight. Tool mortar in joints of exposed or painted exterior surfaces when thumbprint hard. Joints in exposed or painted interior surfaces shall be similarly tooled unless otherwise indicated. Point tight joints in unparged masonry below grade with trowel. Cut flush mortar joints in surfaces to be plastered, stuccoed, or covered with other masonry. Remove mortar protrusions extending into cells or cavities to be reinforced or filled. In no case will vertical joints be allowed within less than one half stretcher length of any exterior angle.

### 3.2.6 Raked Joints

Provide raked joints for caulking on interior face at control joints, end of slip sills, around window and door frames, and at such other locations where caulked joints are indicated. Rake such joints and tool smooth to uniform depth of 20 mm.

### 3.2.7 Bedding

Bed masonry units in accordance with requirements of Section 3 of CAN3-S304.

### 3.2.8 Bond Pattern

Bond pattern shall be stack bond.

### 3.2.9 Intersecting Walls

Intersecting walls shall be tied together in accordance with the requirements of the Drawings.

### 3.2.10 Anchorage

Anchorage of walls shall be in accordance with the Drawings.

### 3.2.11 Partitions

Partitions shall be continuous from floor to underside of floor or roof construction above, unless otherwise indicated. Non-bearing partitions shall be the thickness indicated. Faces of units in exposed walls shall be uniformly smooth and in same plane.

### 3.2.12 Furring

When free standing, masonry furring shall be 75 mm thick unless otherwise indicated, on jambs and other reveals around projections that are indicated as furred with masonry. Anchor furring to masonry walls or concrete with built-in metal anchors spaced not over 600 mm on centres in both directions and positioned to coincide with the joints in masonry furring.

Anchor masonry furring less than 75 mm in thickness with metal ties, spaced as specified above for free-standing furring. Spot bed in mortar against backing masonry. Do not bond furring at columns and for pipe-space enclosures to other masonry but anchor thereto with metal ties.

### 3.2.13 Masonry Fireproofing

Masonry fireproofing around steel columns shall be not less than 75 mm thick unless otherwise indicated; shall be set at least 15 mm away from steel; shall be full thickness at splice plates; and shall not be omitted or reduced in thickness at abutting pipe spaces.

Where reinforcment of masonry fireproofing is indicated, embed wire mesh or masonry joint reinforcement in bed joints at vertical intervals of 400 mm or less.

Leave space between masonry fireproofing unfilled unless otherwise indicated. Place filling, consisting of mortar or grout and whole or broken masonry units where indicated.

### 3.2.14 Fire Brick

None required.

### 3.2.15 Flue Tile

None required.

### 3.2.16 Coarse Grout Fill

Fill all bond beams, fill lintels and pilasters solid with coarse grout. Fill three cores vertically at each corner, intersection, and one core both sides of each opening.

3.2.17 Expansion and Control Joints

Provide expansion and control joints, continuous vertical joints, on both inside and outside of wall as indicated on Drawings. Extend control joints through bond beams, unless otherwise indicated. On exposed-to-view faces of interior walls, rake control joints to depth of 20 mm and neatly tool square and smooth.

3.2.18 Sills and Copings

Set masonry sills and copings with faces plumb and true in full bed of mortar except that precast concrete sills with lugs shall have mortar beds under ends of sill only until completion of walls, at which time remainder of bed joint under sill shall be filled solidly with mortar and tooled smooth on exposed face. Use dowels or other approved means to attach coping to masonry walls. Build-in flashing, or make provision for its installation later in accordance with details. Make dowel holes and other openings in flashing watertight with mastic waterproofing compound. Provide expansion joints and caulking where indicated.

3.2.19 Lintels

Extend lintels at least 200 mm beyond edge of opening. Firmly bed at bearings in mortar of same quality as used in laying wall. Where end(s) of lintels are at control joint(s), level bed joint at such end(s) and cover with sheet of 8 $kg/m^2$ smooth copper with edges cut back 15 mm from face of wall. Rake out bed and end joint for caulking.

3.2.20 Unfinished Work

Step-back unfinished work for joining with new work; toothing is permissible only with approval of the Contractor.

Where fresh masonry abuts partially or fully set masonry, clean exposed surface and dampen existing surface for best possible bond.

3.2.21 Masonry Reinforcing and Anchors

Masonry reinforcing shall be built continuously with a minimum of 6" (150 mm) laps into bed joints 8" (200 mm) and 16" (400 mm) from the floor and 16" thereafter throughout all walls unless otherwise specified on drawings.

Masonry reinforcing shall be placed in the first two consecutive block bed joints over all openings. Filling and reinforcing for bond beams shall be as specified on drawings.

Knock-out blocks shall be used where vertical wall reinforcing intersects horizontal block wall reinforcing.

## 3.3 Field Quality Control

### 3.3.1 Inspection and Testing

Test will be made by an Independent Testing Laboratory appointed by the Contractor.

Cost for tests will be borne by Contractor.

All materials delivered to the job site shall be in accordance with samples tested and approved by the appointed testing agency and approved by the Contractor.

Method of testing will conform to applicable CSA or ASTM standards.

If test results show that design criteria is not met, the authority having jurisdiction may demand evidence that strength capacity of structure is adequate. Perform any additional work required to meet original criteria.

## 3.4 Adjust and Clean

### 3.4.1 Pointing and Cleaning

At completion of work fill all holes in joints of masonry surfaces to be exposed or painted with mortar and suitably tool. Dry brush masonry walls at end of each day's work and also after final pointing, and leave clean and free from mortar spots and droppings. Repair any cracks in masonry.

Wire brushes will not be permitted. Use non-metallic tools in cleaning operations.

END OF SECTION

## CUSTOM STEEL FABRICATIONS

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## 1. GENERAL

### 1.1 Related Work Specified In Other Sections

.1 Structural steel framing: Section 05120
.2 Metal decking: Section 05300
.3 Finish painting: Section 09900

### 1.2 Work Supplied But Installed Under Other Sections

.1 Supply following materials specified to be installed under other Sections of these project specifications:

   .1 Bearing plates, sleeves and other inserts to be built into concrete and masonry elements and required for anchorage and support of fabricated steel components.

.2 Supply instructions and templates as required for accurate setting of inserts and components.

### 1.3 Quality Assurance

.1 Qualifications of Welders:

   .1 Welding of load supporting components shall be performed by companies certified by Canadian Welding Bureau in accordance with CSA W47.1-(latest edition).

   .2 Welders shall be qualified by Canadian Welding Bureau for classification of Work being performed.

.2 Workmanship Standards:

   .1 Resistance Welding: to CSA W55.3-(latest edition).

   .2 Fusion welding: to CSA W59-(latest edition).

### 1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300.

.2 On shop drawings clearly indicate:

   .1 Components
   .2 Core metal thicknesses
   .3 Finishes
   .4 Dimensions
   .5 Fabrication details
   .6 Installation details

## 1.5 Product Delivery and Storage

.1 Schedule delivery of components to site to coincide with installation of this work.

.2 Store components to prevent damage and distortion.

.3 Protect finishes from scratches and soiling.

## 2. PRODUCTS

### 2.1 Materials

.1 Steel sections and plates: to CAN3-G40.20-M81 and CAN3-G40.21-M81, Grade 300W.

.2 Deformed steel bars: of billet steel to CSA G30.12-M(latest edition), Grade 300.

.3 Shop paint: to CGSB 1-GP-40d.

.4 Field paint touch-up: to CGSB 1-GP-40d.

### 2.2 Fabrication

.1 Shop fabricate components where possible.

.2 Fabricate components square, straight, true, free from warpage and other defects. Accurately cut, machine, file and fit joints, corners, copes and mitres.

.3 Exposed joints and connections shall be tight, flush and smooth unless otherwise indicated.

.4 Where work of other Sections is to be attached to work of this Section, prepare work by drilling and tapping holes as required to facilitate installation of such work.

.5 Work of this Section, supplied for installation under other Sections, shall be prepared as required ready for installation.

### 2.3 Surface Preparation

.1 Thoroughly clean and suitably pretreat steel prior to finishing.

.2 Remove loose mill scale, rust, oil, grease, dirt and other foreign matter in accordance with SSPC-SP6-Commercial Blast Cleaning.

.3 Grind smooth sharp projections.

## 2.4 Finishes

.1 Refer to "Schedule of Components" for component finishes. Unless otherwise indicated apply prime paint finish to unscheduled components.

.2 Prime Paint:

- .1 Apply one coat of prime paint to components prior to assembly.
- .2 Apply primer to properly prepared surfaces at temperature above 7°C.
- .3 Leave surfaces to be welded unpainted.
- .4 Apply one prime coat shop paint to all surfaces, except as noted, to a minimum dry thickness of 60 micrometers.

## 3. EXECUTION

## 31. Installation

.1 Install components square, straight and true to line.

.2 Securely anchor components in place. As indicated on drawings.

.3 After installation, site clean and refinish damaged finishes, welds. Refinish with primer or zinc rich paint to match original finish.

END OF SECTION

# STEEL HOLLOW METAL FRAMES

## 1. GENERAL

### 1.1 Related Work Specified In Other Sections

| | |
|---|---|
| .1 Painting | Section 09900 |
| .2 Glass for glazed frames | Section 08800 |
| .3 Finished hardware | Section 08700 |

### 1.2 Quality Assurance

.1 Except as otherwise specified, comply with requirements of Canadian Manufacturing Standards for Steel Doors and Frames published by the Canadian Steel Door and Frame Manufacturers' Association.

.2 Labelled frames shall bear ULC testing agency label.

## 2. PRODUCTS

### 2.1 Materials

.1 Sheet Steel: Commercial quality, cold rolled to ASTM-A366, Class 1 or, commercial quality to ASTM-A526-80, zinc coated to ASTM A525-M-80, ZF075 coating for interior frames.

  .1 Frames 1.6 and 2.0 mm base thickness steel.

  .2 Components/Accessories: in accordance with Canadian Steel Door and Frame Manufacturers' Association manufacturing standard for Steel Doors and Frames, Table 1, except where indicated otherwise.

  .3 Glazing stops: minimum 1.0 mm thick base steel, screw fixed type.

.2 Reinforcing channel: to CSA-G40,21-M81, type W300.

.3 Door Bumpers: black neoprene.

.4 Primer: to CGSB 1-GP-178M, for touch-up.

## 2.2 Fabrication

.1 Fabricate frames to Canadian Steel Door and Frame Manufacturers' Association requirements. Profile and sizes as indicated.

.2 Use 1.6mm thick to fabricate regular door frame and all window frames; and 2.0mm to fabricate door frames with opening more than 1200 mm in width.

.3 Touch-up frames by priming areas where "wipe coated" galvanizing is damaged.

## 3. EXECUTION

## 3.1 Installation

.1 Set frames plumb, square, level and at correct elevation. Limit of acceptable frame distortion - 2mm out of plumb measured on face of frame, maximum twist corner to corner of 3mm.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames solidly to maintain in position while being built-in.

## 3.2 Schedules

.1 Welded Frames:

  .1 Use welded frames at all door and window locations as indicated.

.2 Labelled Frames:

  .1 Use labelled frames where fire rated doors are called for.

END OF SECTION

# HOLLOW METAL DOORS

---

## 1. GENERAL

### 1.1 Related Work Specified In Other Sections

| | | |
|---|---|---|
| .1 | Hollow metal frames | Section 08110 |
| .2 | Supply of hardware and weatherstripping | Section 08700 |
| .3 | Painting | Section 09900 |

### 1.2 Reference Documents

.1 Except as otherwise specified, comply with requirements of Canadian Manufacturing Standards for Steel Doors and Frames published by the Canadian Steel Door and Frame Manufacturers' Association.

### 1.3 Fire Rated Doors

.1 Doors shall bear ULC testing agency label indicating following:

- .1 At standard size openings: fire endurance rating.
- .2 At oversized openings: unclassified as to fire rating.

## 2. PRODUCTS

### 2.1 Materials

.1 Sheet Steel: commercial quality steel, cold rolled to ASTM A526-80, zinc coated to ASTM 525M-80 ZF075 coating designation. 1.2mm thickness.

.2 Core material of steel stiffeners at 150mm O.C. between sheets.

.3 Reinforcement for Hardware: carbon steel, welded in place, prime painted, to the following thicknesses:

| | | |
|---|---|---|
| .1 | Hinge, pivot and panic bar reinforcements: | 3.5mm |
| .2 | Lock face, flush bolts, concealed bolts: | 2.5mm |
| .3 | Concealed or surface closer reinforcements: | 2.5mm |
| .4 | Other surface hardware reinforcements: | 2.5mm |

.4 Primer: to CGSB 1-GP-178M.

## 2.2 Fabrication

.1 Hollow metal doors shall be of seamless construction with no visible seams to joints on faces at vertical edges.

.2 Core construction shall be one of the following:

  .1 Internally steel stiffened with continuous vertical steel stiffeners at 150mm o.c. spot welded to both face sheets; fill voids with glass fibre insulation.

  .2 Composite construction consisting of honeycomb core with steel face sheets pressure laminated to core.

.3 Refer to door schedule for required classes and ratings of fire doors.

.4 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using templates provided.

.5 Join door faces at intersecting edges with continuous welds, fill and grind smooth. Finish door faces flush without visible joints or distortion.

.6 Close top and bottom edges of door with recessed 1.2mm steel channel, full width welded.

.7 Touch-up doors by priming areas where zinc coating is damaged.

.8 Profile edge of doors as follows: Single acting swing doors - Bevel 3mm in 50mm.

## 3. EXECUTION

## 3.1 Installation

.1 Install doors and hardware in accordance with templates and manufacturer's instructions. Maximum permissible warp of 3mm measured diagonally across door.

.2 Adjust operable parts for correct function.

END OF SECTION

# HARDWARE

---

## 1. GENERAL

### 1.1 Related Work Specified In Other Sections

.1 Prepared metal door frames: Section 08110.

### 1.2 Product Options and Substitutions

.1 Refer to Section 01620 for requirements pertaining to product options and substitutions.

### 1.3 Submittals

.1 Hardware Schedule: in accordance with the requirements of Section 01300, submit a hardware schedule showing the quantities, type and location of all items of finish hardware required for the Project. Submit as many additional copies as may be required for the use of this Section and the Subcontractor.

.2 After completion of all construction work, certify on an approved form, that all items of finish hardware have been adjusted and are working properly and that all hardware on fire rated labelled doors conforms to the requirements of (ULC) Underwriters Laboratories of Canada.

### 1.4 Maintenance

.1 Upon completion of the work, provide to the Contractor, manufacturer's parts list, manufacturer's instructions for door closers and locksets, also two (2) sets of wrenches for door closers and locksets.

.2 Brief the building maintenance staff regarding the proper care of hardware such as lubrication of locksets, adjustments of door closers, cleaning and general meintenance.

### 1.5 PROTECTION

.1 Protect knobs, handles, with adhesive release paper, of a type which is easily removed without marring of finish.

## 1.6 Packaging, Labelling and Delivery

.1 Packaging: Include, with each item of hardware the following:

- Screw, bolts and fasteners necessary for installation.
- Installation instructions.
- Special tools required for installation.

.2 Delivery and Labelling; Deliver finish hardware with all items in individual packages, legibly marked and adequately labelled indicating the part of the work for which it is intended. Deliver hardware required for shop application in ample time so as not to impede the progress of the work.

## 2. PRODUCTS

## 2.1 Hardware

.1 Finishing hardware suppliers shall be registered in the Province of Alberta, be well established in this field, with adequate equipment, maintenance, and advisory facilities, in order to service and keep pace with contract obligations and responsibilities.

.2 Provide all hardware listed in the schedule on drawing.

## 2.2 Schedule of Finish Hardware

.1 See drawings for hardware schedule.

END OF SECTION

# GLASS AND GLAZING

---

## 1. GENERAL

### 1.1 Related Work Specified in Other Sections

| | |
|---|---|
| .1 Hollow metal frame: | Section 08110. |
| .2 Sealants and caulking between frames and other building components. | Section 07910. |

## 2. PRODUCTS

.1 Georgian polished wired glass: to CAN2-12.3-M76 6mm thick. Approved manufacturer - Canadian Pittsburgh Industries Ltd.

### 2.2 Glazing Compounds

.1 Glazing Tape: preformed butyl tape (with integral shimming device), 1015 durometer hardness, 100mm release, grey colour, 3mm thick 6mm wide.

.2 Setting Blocks: neoprene, 80 durometer hardness, 100mm long x 10mm thick x 10mm high.

.3 Spacer Shims: neoprene, 50 durometer hardness, 75mm long x 2mm thick x 10mm high.

## 3. EXECUTION

### 3.1 Installation (Interior)

.1 Dry Method (tape/tape)

.1 Cut glass to the correct sizes as indicated on Drawings and allow for expansion. Remove all protective coatings and clean with recommended solvent on contact surfaces.

.2 Cut glazing tape to proper length and install against permanent stop.
.3 Place setting blocks at 1/4 points and remove paper backing from tape.
.4 Install glass, rest on setting blocks, push against tape for full contact.
.5 Place glazing tape on free perimeter of glass in same manner described above.
.6 Install removable stop, avoid displacement of tape, exert pressure on tape for full continuous contact.

3.2 Cleaning

.1 After installation mark glass with an "X" by using tape or removable paste. Use tape on interior surfaces only.

.2 Immediately remove droppings from finished surfaces. Remove labels after work is complete.

END OF SECTION

SECTION: 4
JOB NO.: A149-15
AGMT NO.:A149-15-SC-003

# EXHIBIT "A"

# SCOPE OF WORK

# ELECTRICAL

IMPROVEMENTS TO THE HEAVY OIL

MINI-PLANT RESEARCH FACILITY
DEVON ALBERTA

## 1.0 Scope Of Work

1.1 The work shall include, but shall not be necessarily limited to, the furnishing of all labour, materials, tools, equipment and services for and incidental to the following catagories of work as listed herein and shown on the drawings.

### 1.2 Electrical Work

a) Supply and installation of all wiring and wireways for power, control, instrumentation, lighting and miscellaneous components as noted on the drawings and specifications.

b) Disconnect, remove and turn over to the Owner the following electrical components;

- Lighting fixtures
- Receptacles
- Welding receptacles
- All conduit and wiring associated with lighting, receptacles and welding outlets.

c) Supply and install all electrical fixtures, receptacles, switches, relays, relay cabinets and other electrical components.

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SECTION: 5
JOB NO.: A149-15
AGMT NO.:A149-15-SC-003

# EXHIBIT "B"

# DRAWINGS AND SPECIFICATIONS

IMPROVEMENTS TO THE HEAVY OIL
MINI-PLANT RESEARCH FACILITY
DEVON ALBERTA

## 1.0 Drawings and Specifications

1.1 The Subcontractor shall comply with all applicable local, provincial and federal laws, codes, orders and regulations.

1.2 The work shall be performed in accordance with the standards and practices contained in the following specifications and drawings.

| Section No. | Title |
|---|---|
| 01300 | Submittals |
| 16020 | General Electrical Provisions |
| 16030 | Electrical Wiring, Lighting Power and Cables |

| Drawing No. | Title | Rev. No. |
|---|---|---|
| 401 | Area Classification, Lighting and Power Plan | 0 |
| 402 | Single Line and Schematic Diagrams | 0 |

# SUBMITTALS

## 1. SHOP DRAWINGS

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Subcontractor to illustrate details of a portion of the Work.

.2 The Subcontractor shall arrange for the preparation of clearly identified shop drawings as called for by the Contract Documents and for such other items as the Contractor may reasonably request.

.3 Shop drawings shall be prepared in accordance with the Manual on Metric Building Drawings Practice published by the National Research Council of Canada. Conformance with sections 4.1 to 4.9 of the manual is not mandatory.

.4 Prior to submission to the Contractor, the Subcontractor shall review all shop drawings. By this review, the Subcontractor certifies that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and certifies that he has checked and coordinated each Shop Drawing with the requirements of the Work and of the Contract Documents. The Subcontractor's review of each shop drawing shall be indicated by stamp, date and signature of a responsible person.

.5 Not less than two (2) of shop drawings shall be submitted through the Subcontractor to the Contractor. In addition, the Subcontractors, if he deems necessary, shall arrange with his Suppliers for any additional copies of shop drawings that he (the Subcontractor) shall require. The shop drawings, when submitted to the Contractor, shall bear the date stamp of, and be checked by, the Subcontractor.

.6 When submitting the shop drawings the Subcontractor shall notify the Contractor in writing, on the shop drawings, of any changes that he has made, from that which has been called for in the drawings and specifications. Failure of the Subcontractor to check or have corrected or indicate any change and variation, in submitting shop drawings, will result in their return to the Subcontractor without consideration or checking by the Contractor.

.7 If the shop drawings are rejected by the Contractor he will return one (1) copy to the Subcontractor, and retain one (1) copy. All other copies shall be destroyed.

.8 The Subcontractor shall resubmit not less than two (2) copies plus any additional copies, as before described, of the revised shop drawings.

.9 After review, the Contractor will retain one (1) copy and return the remaining copy to the Subcontractor, who shall then distribute the shop drawings to all parties concerned.

.10 The Contractor's review of such drawings or of the revised drawings shall not relieve the Subcontractor from respsonsibility for errors or for changes made from the Contractor's drawings or specifications.

## 2. SAMPLES

.1 The Subcontractor shall submit for the Contractor's review, such standard manufacturers' samples as the Contractor may reasonably require. Samples shall be labelled as to origin and intended use in the Work.

.2 The Subcontractor shall provide samples of special material assemblies, or components when so specified.

## 3. OPERATING/MAINTENANCE MANUALS

.1 Provide Contractor with 3 copies of Operating and Maintenance Data, as called for in the Contract Documents, made up as follows:

    .1 Bind data in vinyl hard cover, 3 ring, extention type, loose leaf binder for 215 x 380 mm size paper.

    .2 Enclose title sheet, labelled "Operating and Maintenance Data Manual", project name, date, and list of contents.

    .3 Organize contents into applicable sections of work to parallel project specifications section breakdown. Identify each section with tabs of laminated mylar plastic. (See Section 15010 for specific Mechanical colored tab requirements).

.2 Include the following information plus data specified:

  .1 Maintenance instructions for finished surfaces and materials.

  .2 Copy of hardware and paint schedules.

  .3 Names, address, and phone numbers of Sub Trades and Suppliers.

  .4 Guarantees, warranties, and bonds showing:

    .1 Name and address of project.

    .2 Warranty/Guarantee/Bond commencement date and duration.

    .3 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.

    .4 Additional material/equipment used in project listed under various sections showing name of manufacturer and source of supply.

.3 Neatly type lists and notes. Use clear drawings, diagrams, or manufacturer's literature.

.4 Include one complete set of reviewed shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.

.5 Submit Operating and Maintenance Manuals before or with application for Interim Acceptance.

END OF SECTION

## GENERAL ELECTRICAL PROVISIONS

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### 1. RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 General requirements Division 1

### 2. SCOPE OF WORK

.1 The work shall include, but shall not be necessarily limited to, furnishing of all labour, materials, tools, equipment and services for, and incidental to, installation of power, control, instrumentation, lighting and miscellaneous components as listed herein and/or shown on the drawings. The electrical construction portion of the system covers the complete installation of electrical materials, sequence wiring, power wiring, instrumentation testing and checking as indicated on the drawings and enumerated in this specification.

.2 Subcontractor shall visit the site and obtain relevant information and include in this bid all costs associated with field investigations, demolition work and Tie-in work in the existing equipment. Subcontractor shall obtain building maintenance personnel and/or Federal Pioneer Limited's assistance to complete the Tie-in work in the existing main building electrical room.

.3 Installations and material in plant area shall conform to Class I, Group D, Div. 1 area classification and general purpose installations in the electrical room. All explosion proof materials shall be used in the plant area and conduit seals as per CEC.

.4 disconnect, remove and turn it over to the Owner's storage area the following electrical components.

a) Lighting fixtures
b) Receptacles
c) Unit heater wiring
d) Welding receptacles
e) All conduit and wiring associated with lighting, receptacles and welding outlets
f) Receptacles mounted on exterior of the building
g) Some components around main splitter box, lighting panel and lighting transformer demolition work is included under separate scope of work.

.5 Install lighting fixtures, receptacles and switches

.6 Connect size #1 starters for EF#1, EF#2 in MCC 01 and V-1 at air makeup unit.

.7 Connect airflow switch, damper motor and relay cabinet wiring.

.8 Install KEI-RP1 relay cabinet.

.9 Connect unit heaters, exhaust fans, air makeup unit.

.10 Re-wire existing 125V D.C. shunt trip circuit to accomodate an external contact CR2 in main electrical room. Existing F.P.E. series H-3 feeder breaker shall be modified by adding an 120V AC, time delay under voltage relay (time setting for 5 sec.). Contact Federal Pioneer Ltd., Mr. David Roh (452-9971) for supply and modification costs.

.11 Install conduit and wiring from main building electrical room to mini plant research centre.

.12 All openings shall be sealed with fire rated sealant.

## 3. EQUIPMENT SUPPLIED BY OTHERS OR EXISTING EQUIPMENT

a) MCC-01
b) Delta-Relay panel
c) Starters for heating and ventilating equipment
d) Shunt trip in main electrical room
e) Spare breakers in lighting panel and emergency panel

## 4. REGULATORY REQUIREMENTS

.1 Equipment, materials, wiring, wiring devices and complete operating electrical system shall meet requirements of applicable sections of the Canadian Electrical Code.

.2 Comply with by-laws of local electrical authority.

.3 Use only C.S.A. approved electrical materials and equipment.

.4 Subcontractor shall obtain the permit from local inspection authorities.

## 5. INSPECTION AND TESTING

.1 Before energizing any portion of the electrical system, perform Megger tests on all parts of the distribution system. Results shall conform to Canadian Electrical Code, to the satisfaction of authorized inspection authority and Kilborn Energy Inc.

## 6. SOURCE OF SUPPLY

.1 Maintain uniformity of manufacture for all like materials and equipment.

## 7. RECORD DRAWINGS

.1 Keep daily record of "as is" work on fresh set of ozalid prints supplied by the Kilborn Energy Inc. Indicate the following:

  .1 Deviations from Subcontract Drawings.
  .2 Additions and deletions from Subcontract Drawings.
  .3 Locations of pull boxes.
  .4 Locations of feeders.
  .5 Locations of electrical equipment.

.2 On completion of work, submit complete record drawings to Kilborn Energy Inc.

## 8. SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01300. Shop drawings for lighting fixtures, relay panel shall be submitted.

## 9. CERTIFICATES

.1 On completion of work, submit certificate of acceptance from inspection authority to the Kilborn Energy Inc.

## 10. OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into maintenance manual specified in Section 01300.

.2 Include in operation and maintenance data:

  .1 Details of design elements, construction features, component function and maintenance requirement to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of intallation.

.2 Technical data, product data, component illustration, exploded views, technical descriptions of items and parts list.

.3 Wiring and schematic diagrams and performance curves.

.4 Names and addresses of local suppliers for items included in maintenance manuals.

END OF SECTION

# ELECTRICAL WIRING, LIGHTING POWER AND CABLES

---

## 1. WIRE AND CABLE

.1 Wire shall be color coded in accordance with the Canadian Electrical Code.

.2 Unless otherwise specified, no wire smaller than #12 AWG gauge copper shall be used.

.3 Unless otherwise specified, aluminum wire shall not be used.

.4 All wiring shall be rated for 600 volts, RW-90, X-Link insulation.

.5 Wire and cable shall be to satisfaction of inspection authority and to approval of the Kilborn Energy Inc. for use to which it is put and location where it is used.

## 2. CONDUIT

.1 Wire and cable shall be run in rigid conduit sized according to table 6 of the Canadian Electrical Code. EMT may be used where permitted by inspection authority, except in concrete slabs on grade, where rigid conduit shall be used.

.2 For underground runs outside of building, use rigid PVC conduit. Unless noted otherwise, CSA approved plastic pipe may be used.

.3 Grounding conductor of proper size shall be installed in all conduit or EMT run underground, in concrete on or below grade, or any other location where it may be subject to corrosion.

.4 Make connections to mechanical motors and equipment with PVC jacketed flexible conduit and liquid tight connectors or explosion proof flexible conduit to meet area classification requirements.

## 3. OUTLETS

.1 Electrical outlets shall be provided with an outlet box and suitable cover.

## 4. FIXTURES

.1 All fixtures shall be complete with lamps or tubes and accessories required to leave the fixture complete in position and operating. Fixtures shall be designed to accommodate 1160 mm metric fluorescent tubes where required.

.2 Incandescent lamps shall be 1000 hour, clear where inside a globe and frosted where open.

.3 Fluorescent lamps shall be metric F40 T-12 rapid start, 1160 mm length (face to face), warm white, 3200 initial lumens. Note that 1198 mm (48 inch) lamps or 1160 mm lamps with adaptors are not acceptable under any circumstances.

.4 Balasts shall be 2 lamp, high power factor, best sound rating available rapid start built to CBM Standard. The following manufacturers are acceptable:

.1 C.G.E.
.2 Westinghouse
.3 Advance
.4 Sola

## 5. PANELS AND BREAKERS

.1 Panels and circuit breakers shall be the standard products of one of the following manufacturers:

.1 Westinghouse
.2 C.G.E.
.3 F.P.E.
.4 Square D
.5 I.T.E.

.2 Circuit breakers in panels shall have toggle handles and shall have an ON-OFF and TRIPPED position.

.3 Motor circuit breakers shall have facilities to padlock breaker in open position.

## 6. MOTOR PROTECTION

.1 Motor protection switches shall be one of the following makes, complete with all necessary overload heaters and relays:

- .1 Allen Bradley
- .2 Westinghouse
- .3 C.G.E.
- .4 Cutler Hammer
- .5 Canadian Controllers
- .6 Square D
- .7 Klockner Moeller
- .8 Telemecanique

.2 Switches occuring in a finished area shall be flush mounted.

## 7. WIRING DEVICE

.1 Where possible all wiring devices shall be flush mounted. Unless noted otherwise, wall switches and receptacles shall be installed 1300 mm and 30 mm above floor respectively. Where brick, concrete blocks walls, etc., are used, wiring devices shall be installed to nearest course line.

.2 Where it is not possible to flush mount wiring devices, the wiring devices shall be installed in stamped metal boxes complete with metal cover.

.3 Wall switches shall be ivory toggle handle finished with an ivory plate. The following products are acceptable:

- .1 Leviton 5501
- .2 Smith and Stone 4601
- .3 Hubble 1101
- .4 Bryant 1101
- .5 Arrow Har 1101
- .6 C.G.E. 5911
- .7 Mutac 53691

.4 Two pole, three way and four way switches shall be of the same series.

.5 Receptacles shall be invory and finished with an ivory plate. The following products are acceptable:

  .1 Hubbell 5252
  .2 Bryant 5252
  .3 C.G.E. 4060
  .4 Leviton 5014
  .5 Smith and Stone 1-1144

.6 All standard switches and receptacles shall be by the same manufacturer.

## 8. TELEPHONE SYSTEM

.1 Supply and install an empty conduit for telephones as indicated on the drawings.

.2 Main service conduit shall be 32 mm minimum for aerial service or 50 mm minimum for underground service.

.3 Main service Type "T" cabinet minimum 600 mmx750 mmx100 mm, complete with lockable hinged door and integral 19 mm plywood backboard. In Storage and Electrical Rooms provide a 1200 mmx1200 mmx19 mm painted plywood backboard.

.4 Minimum size conduit used for outlet runs shall be 20 mm. Conduits shall be stubbed 50 mm onto backboards.

.5 Near cabinet or backboard install a duplex convenience outlet.

.6 A #6 green insulated copper ground conductor shall be installed to each main terminal location.

.7 A 40 kg test nylon line shall be installed in all underground entrance conduits and runs exceeding 30 m in total length.

.8 Installation shall be in accordance with all the regulations and requirements.

## 9. AUXILIARY SYSTEM

.1 Auxiliary systems such as fire-alarms, clocks, doorbells, buzzers, etc., shall be supplied and installed as indicated and noted on Drawings.

## 10. MAIN SERVICE

.1 Supply and install a main service complete with all necessary metering equipment.

.2 Enitire main service installation shall be approved by power company, inspection authority and Kilborn Energy Inc.

.3 Refer to Section 01014 - Mechanical and Electrical Service connections for requirements pertaining to responsibility for electrical services and connections.

## 11. RELAY PANEL

.1 Subcontractor shall prepare a detailed relay panel layout, wiring diagram and bill of material specification drawings.

.2 Relay panel enclosure shall be EEMAC type 7CD-9ECG made of die cast aluminum. It shall be suitable for mounting on concrete block wall with unistrut brackets. Enclosure shall be suitable for Class I, Div. 1, Group 'D' area installation.

.3 Terminal blocks shall be non-hygroscopic Weidmueller SAC 4 or approved equal and shall use "captive" screws for terminals.

.4 Wireways shall be panduit, panduct.

.5 Indicating lights and horn shall be flush mounted on front of the door.

.6 All wiring shall be copper, RW-90, X-Link. Minimum wire size shall be #14 AWG and no more than two wires shall terminate on any terminal.

.7 Relays shall be as per the listing

TR1 = AGASTAT Model # 70-2-2-A-D
TR2 = AGASTAT Model # 70-1-2-A-C
TR3 = AGASTAT Model # 70-1-2-A-D
CR = ALLEN BRADLEY # 700 R series

All relays shall have 120V, 60 HZ coils and shall be installed on mounting strips.

HORN = 120V A.C., low current, preferably flush mounted on front of relay panel Edwards or equal suitable for Class I, Div. 1, Group 'D'.

8 CR2 contact wiring to shunt trip is DC wiring. Subcontractor to ensure the terminal layout and wiring meets CSA requirements. I.E. installation of barriers and separate conduit etc.

12. FIXTURE SCHEDULE

(A) 250W, 120V AC, HPS, Pendant mount fixture complete with dome reflector, guard, lamp and other accessories.

Crouse-Hinds # EVMA43251 series or approved equal.

(B) 100W, 120V AC, HPS, Ceiling mount fixture complete with dome reflector, guard and lamp.

(C) 1' x 4', 2-40 WAH Fluorescent fixture, with wraparound lense and surface mounted.

YORK # B248-15

(D) Keene # VCXL-11GC, 100W, 120V AC, Incandescent fixture, surface mounted.

(E) 15 AMP, 120V AC, Explosion proof receptacle Crouse-Hind # CPS152-201 series or equal.

(F) 15 AMP 120V AC, Duplex receptacle HUBBELL #5320/001

(G) 15 AMP, 120V AC, single pole switch HUBBELL #53501/001

(H) 15 AM 120V AC, single pole switches in a 4-Gand explosion proof enclosure. Crouse-Hinds # EFS series or equal.

END OF SECTION

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SECTION: 4
JOB NO.: A149-15
AGMT NO.:A149-15-SC-002

# EXHIBIT "A"

# SCOPE OF WORK

# MECHANICAL

IMPROVEMENTS TO THE HEAVY OIL
MINI-PLANT RESEARCH FACILITY
DEVON ALBERTA

I

## 1.0 Scope Of Work

1.1 The work shall include, but shall not be necessarily limited to, the furnishing of all labour materials, tools, equipment and services for and incidental to the following catagories of work as listed herein and shown on the drawings.

### 1.2 Mechanical Work

a) The supply and installation of air supply unit V-1 complete with motor, motor starter, air inlet damper and controls.

b) Design, fabricate and instal air supply unit V-1 structural support to position V-1 approximately 30 inches above finished grade.

c) Supply and installation of two unit heaters UH-1 and UH-2 complete with thermostats.

d) Supply and installation of two exhaust fans EF-1 and EF-2 complete with prefabricated roof curb, flashing and roof opening framing steel.

e) Supply and installation of air supply and exhaust ducting complete with manual and motorized dampers, grilles, diffusers and fire dampers.

f) Supply and installation of package water cooled air conditioning unit AC-1 complete with thermostat.

g) Supply and installation of interconnecting glycol/water piping, gas regulator and piping, and cooling water piping.

h) Supply and installation of equipment, duct and piping support hardware.

i) Supply and installation of the metal roof deck, mesh and concrete topping.

j) Supply and installation of concrete slab base for air supply unit V-1.

k) Supply and installation of equipment, duct and piping insulation.

l) Painting of concrete block walls, non galvanized metal surfaces as described on the drawings and specifications.

m) Removal of two existing gas fired unit heaters, gas piping, patch and make weather tight all building penetrations.

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SECTION: 5
JOB NO.: A149-15
AGMT NO.:A149-15-SC-002

# EXHIBIT "B"

## DRAWINGS AND SPECIFICATIONS

IMPROVEMENTS TO THE HEAVY OIL
MINI-PLANT RESEARCH FACILITY
DEVON ALBERTA

## 1.0 Drawings and Specifications

1.1 The Subcontractor shall comply with all applicable local, provincial and federal laws, codes, orders and regulations.

1.2 The work shall be performed in accordance with the standards and practices contained in the following specifications and drawings.

| Section No. | Title |
|---|---|
| 01300 | Submittals |
| 03300 | Cast-In-Place Concrete |
| 05120 | Structural Steel |
| 05300 | Metal Decking |
| 09900 | Site Painting and Finishing |
| 15010 | General Mechanical Provisions |
| 15042 | Testing |
| 15043 | Balancing |
| 15060 | Pipe & Pipe Fittings |
| 15090 | Supports, Anchors and Seals |
| 15100 | Valves, Rocks and Fawcets |
| 15181 | Piping and Equipment Insulation |
| 15190 | Duct Insulation |
| 15811 | Direct Fired Units |
| 15840 | Ductwork |
| 15860 | Duct Accessories |

| Drawing No. | Title | Rev. No. |
|---|---|---|
| 301 | H.V.A.C. Layout | 0 |
| 101, 901 | Control Room Plans, | 0 |
| | Elevations, Sections and Details | 0 |

## SUBMITTALS

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### 1. SHOP DRAWINGS

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Subcontractor to illustrate details of a portion of the Work.

.2 The Subcontractor shall arrange for the preparation of clearly identified shop drawings as called for by the Contract Documents and for such other items as the Contractor may reasonably request.

.3 Shop drawings shall be prepared in accordance with the Manual on Metric Building Drawings Practice published by the National Research Council of Canada. Conformance with sections 4.1 to 4.9 of the manual is not mandatory.

.4 Prior to submission to the Contractor, the Subcontractor shall review all shop drawings. By this review, the Subcontractor certifies that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and certifies that he has checked and coordinated each Shop Drawing with the requirements of the Work and of the Contract Documents. The Subcontractor's review of each shop drawing shall be indicated by stamp, date and signature of a responsible person.

.5 Not less than two (2) of shop drawings shall be submitted through the Subcontractor to the Contractor. In addition, the Subcontractors, if he deems necessary, shall arrange with his Suppliers for any additional copies of shop drawings that he (the Subcontractor) shall require. The shop drawings, when submitted to the Contractor, shall bear the date stamp of, and be checked by, the Subcontractor.

.6 When submitting the shop drawings the Subcontractor shall notify the Contractor in writing, on the shop drawings, of any changes that he has made, from that which has been called for in the drawings and specifications. Failure of the Subcontractor to check or have corrected or indicate any change and variation, in submitting shop drawings, will result in their return to the Subcontractor without consideration or checking by the Contractor.

.7 If the shop drawings are rejected by the Contractor he will return one (1) copy to the Subcontractor, and retain one (1) copy. All other copies shall be destroyed.

.8 The Subcontractor shall resubmit not less than two (2) copies plus any additional copies, as before described, of the revised shop drawings.

.9 After review, the Contractor will retain one (1) copy and return the remaining copy to the Subcontractor, who shall then distribute the shop drawings to all parties concerned.

.10 The Contractor's review of such drawings or of the revised drawings shall not relieve the Subcontractor from respsonsibility for errors or for changes made from the Contractor's drawings or specifications.

## 2. SAMPLES

.1 The Subcontractor shall submit for the Contractor's review, such standard manufacturers' samples as the Contractor may reasonably require. Samples shall be labelled as to origin and intended use in the Work.

.2 The Subcontractor shall provide samples of special material assemblies, or components when so specified.

## 3. OPERATING/MAINTENANCE MANUALS

.1 Provide Contractor with 3 copies of Operating and Maintenance Data, as called for in the Contract Documents, made up as follows:

  .1 Bind data in vinyl hard cover, 3 ring, extention type, loose leaf binder for 215 x 380 mm size paper.

  .2 Enclose title sheet, labelled "Operating and Maintenance Data Manual", project name, date, and list of contents.

  .3 Organize contents into applicable sections of work to parallel project specifications section breakdown. Identify each section with tabs of laminated mylar plastic. (See Section 15010 for specific Mechanical colored tab requirements).

.2 Include the following information plus data specified:

  .1 Maintenance instructions for finished surfaces and materials.

  .2 Copy of hardware and paint schedules.

  .3 Names, address, and phone numbers of Sub Trades and Suppliers.

  .4 Guarantees, warranties, and bonds showing:

    .1 Name and address of project.

    .2 Warranty/Guarantee/Bond commencement date and duration.

    .3 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.

    .4 Additional material/equipment used in project listed under various sections showing name of manufacturer and source of supply.

.3 Neatly type lists and notes. Use clear drawings, diagrams, or manufacturer's literature.

.4 Include one complete set of reviewed shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.

.5 Submit Operating and Maintenance Manuals before or with application for Interim Acceptance.

END OF SECTION

# CAST-IN-PLACE-CONCRETE

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## 1. GENERAL

### 1.1 Related Work Specified in Other Sections

.1 Supply of Bearing Plates for Structural Steel Work: Section 05120

### 1.2 Work Installed But Supplied Under Other Sections

.1 Install following materials specified to be supplied under other Sections of these project specifications:

  .1 Fabricated components, sleeves and other inserts to be built into concrete, and or Block walls.

### 1.3 Reference Standards

.1 Perform cast-in-place concrete work in accordance with the following standards except where specified otherwise.

.2 Concrete Materials and Methods of Concrete Construction - CAN3-A23.1-M77.

.3 Methods of Test for Concrete - CAN3-A23.2-M-77.

.4 American Society for Testing and Materials - ASTM - where noted.

.5 Welding of Reinforcing Bars in Reinforced Concrete Construction - CSA W186-M1981.

.6 Erection, Maintenance and Removal of formwork - conform to applicable safety regulations.

.7 American Concrete Institute Detailing Manual - AC 315-74 where noted.

.8 Concrete Reinforcing Steel Institute - CRSI where noted.

### 1.4 Inspection and Testing

.1 Concrete work may be tested by a testing firm retained by the Contractor.

.2 If required, provide casual labour to the testing firm's field personnel for the purpose of obtaining and handling sample materials.

.3 Advise testing firm in advance of concrete placement.

.4 Results of concrete tests will be forwarded to the Contractor and to the Subcontractor. Included with the results will be the following information: Name of Project, Date of Sampling, Name of Supplier, Delivery Truck Number, Identification of Sampling and Testing Technician and exact location in the structure of the concrete sampled.

.5 Testing firm personnel are not authorized to revoke, relax, enlarge or release any requirements of the specification, nor to approve or disapprove any portion of the work.

## 1.5 Shop Drawings

.1 Submit shop drawings, including placing drawings for reinforcing steel and welded steel wire fabric in accordance with Section 01300.

.2 Support and placing details of reinforcing to ACI 315 and CRSI.

## 1.6 Acceptability

.1 Failure to comply with the requirements which control strength will result in the structure being considered potentially deficient.

.2 A structure will be considered potentially deficient when:

  .1 Concrete strength not as specified.

  .2 Reinforcing steel size, quantity, position, quality or arrangement not as specified or detailed.

  .3 Improper curing.

  .4 Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

  .5 Mechanical injury from fire, construction overload or premature removal of forms.

  .6 Poor workmanship.

  .7 Failure to have the Contractor inspect and approve formwork and reinforcement before placing concrete.

.8 Concrete which differs from the required dimensions.

.3 Strength evaluation tests and analysis.

.1 The Contractor may order an independent testing firm to obtain cores, x-rays, or similar non-destructive test.

.2 The Contractor may order a load test and/or analysis as defined by CAN3-A23.3-M77 Section 18, if the non-destructive tests are impractical or inconclusive.

.3 Reinforce by additional construction or replace as directed by the Contractor at own expense, concrete judged inadequate by structural analysis or by results of load tests.

.4 Pay the cost of testing and/or analysis which is required to demonstrate the adequacy of the structure which does not meet the requirements for strength or which has been placed before formwork and reinforcing have been inspected by the Contractor.

.5 The Contractor may order additional testing at any time even though the required tests indicate that the strength requirements have been met. In this instance the Contractor will pay for those tests that meet the specified requirements and the Subcontractor shall pay for those that do not.

## 2. PRODUCTS

### 2.1 Concrete Materials

.1 Portland Cement: to CAN3-A5-M83 Normal-Type 10.

.2 Water, Fine Aggregates and Coarse Aggregates: to CAN3-A23.1-M77, Sections 4 and 5.

.3 Air Entraining Admixtures: to CAN3-A266.1-M78.

.4 Chemical Admixtures: to CAN3-A266.2-M78.

.5 Pozzolanic Mineral Admixtures: to CAN3-A266.3-M78.

## 2.2 Concrete Accessories

.1 Liquid Membrane Forming Curing Compound: CAN3-A23.1-M77.

.2 Grout: non-shrink premixed types with a minimum of 16 MPa compressive strength at 24 hours.

## 2.3 Reinforcing Materials

.1 Welded Steel Wire Fabric: to CSA G30.5-M1983.

.2 Chairs, Bolsters, Bar Supports, Spacers: adequate for strength and support of reinforcing.

## 2.4 Formwork Materials

.1 Formwork: to CAN3-A23.1-M77, Section 11.

.2 Form Oil: non-straining and non-volatile type.

## 2.5 Concrete Mixes

.1 Supply "Controlled Concrete" with 28 day strengths as defined by CAN3-A23.1-M77 as noted on drawings, 21 MPa.

.2 Non-specified admixtures not permitted unless approved by the Contractor.

.3 Concrete slumps shall conform with following table:

| Structural Component | Slump |
|---|---|
| Slabs | 80 mm |

## 2.6 Fabrication of Concrete Reinforcement

.1 Hooks, Bends, Laps and Similar Details to ACI Detailing Manual 315-74, and Metric Supplement of the Reinforcing Steel Institute of Ontario (R.S.I.O.) Manual of Standard Practice.

## 3. EXECUTION

### 3.1 Placing Reinforcing Steel

.1 Place reinforcement within a tolerance of 6mm for slab steel and 12mm for other steel. Bends and end of bars shall be within 50mm of specified location.

.2 Provide minimum concrete cover to reinforcing steel in accordance with CAN3-A23.1-M77, Section 12, except where indicated otherwise on drawings.

### 3.2 Placing Concrete

.1 Place concrete as a continuous operation stopping only at construction joints indicated on the drawings or as follows: In walls and Pilasters immediately above or below roof construction.

### 3.3 Finishing Flatwork

.1 Deck to have smooth level broom finish.

### 3.4 Curing

.1 Initial Curing: Keep concrete surface continuously moist until concrete temperature has dropped several degrees.

.2 Final Curing: Immediately following initial curing and before the concrete has dried cure for an additional seven days, at which time the temperature of the air in contact with the concrete is above 10°C.

.3 Acceptable Curing Methods:

  .1 Ponding or continuous sprinkling.

  .2 Absorptive mat or fabric kept continuously wet.

  .3 Damp sand, earth, or similar moist material.

  .4 Continuous steam vapour mist bath not exceeting 66°C.

  .5 Curing compound.

.6 Curing coumpounds shall not be used on concrete surfaces to receive topping or other type of bonded finish unless aproved by the Contractor.

3.5 Grout

.1 Mix to flowable consistency and apply in accordance with manufacturer's instructions.

END OF SECTION

# STRUCTURAL STEEL

## 1. GENERAL

### 1.1 Related Work Specified In Other Sections

| | |
|---|---|
| .1 Metal decking: | Section 05300 |
| .2 Finish painting: | Section 09900 |
| .3 Metal Fabrications | Section 05500 |

### 1.2 Reference Standards

.1 Conform to CSA S16-(latest edition) and CSA S136-(latest edition).

.2 Conform to CSA W59-(latest edition) for welding, fabrication and erection.

.3 Welding shall be undertaken only by a company approved by the Canadian Welding Bureau to the requirements of CSA W47.1-(latest edition), Certification of Companies for Fusion Welding of Steel Structures.

.4 Conform to Canadian Institute of Steel Construction - C.I.S.C. - Code of Standard Practice for Buildings.

.5 Conform to American Society for Testing and Materials where indicated.

### 1.3 Design

.1 Design connections and other work not shown on the drawings, but necessary for the completion of the work, in accordance with CSA S16-(latest edition).

.2 Include additional work noted above on shop drawings.

### 1.4 Inspection and Testing

.1 Prior to erection examine existing work on which this work will be dependent and report findings to Contractor.

.2 Structural steel work may be subject to inspection and testing, by a firm employed by the Contractor.

.3 Notify Contractor at commencement of shop work so that testing and/or inspection may be scheduled.

.4 When defects are revealed, the Contractor may request additional inspection and/or testing.

.5 Pay for the additional testing and/or inspection that may be required as a result of previous item.

.6 Correct defects and irregularities under the supervision of the Contractor.

.7 Pay costs involved with making the corrections noted in the previous item.

## 1.5 Shop Drawings

.1 Submit shop and erection drawings prior to fabrication in accordance with Section 01300.

.2 Show framing and grid lines, erection plans, bearing and anchorage details, framed openings, accessories, schedule of materials, camber and loadings, fasteners and welds using basic weld symbols.

.3 Shop drawings for work designed by fabricator shall bear the stamp and signature of a professional engineer registered in the Provice of Alberta.

## 2. PRODUCTS

## 2.1 Materials

.1 Structural Steel: To CSA G40.20-M(latest edition) for general requirements.

.2 Structural Steel: To CSA G40.21-(latest edition), shapes plates and bars to Grade 300W.

.3 Shop Paint: To CGSB 1-GP-40d.

.4 Field Paint Touch-Up: To CGSB 1-GP-40d.

## 2.2 FABRICATION

.1 Fabricate to CSA S16-(latest edition) and CSA S136-(latest edition).

.2 Prepare surfaces before welding either by leaving unpainted or remove paint by burning with a carbon electrode and wire brushing.

.3 Shop paint structural steel except surface to be concreted and welded.

.4 Cleaning shall be in accordance with SSPC-SP6-Commercial Sand Blasting.

## 3. EXECUTION

### 3.1 Erection

.1 Erect to CSA S16-(latest edition), Section 33 and CSA S136-(latest edition).

.2 Make provisions for erection procedure, temporary bracing and loads during erection.

.3 Touch up welds and abrasions with shop paint in field.

.4 Do not alter members in field without Contractors approval.

END OF SECTION

# METAL DECKING

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## 1. GENERAL

### 1.1 Related Work Specified In Other Sections

.1 Concrete cover: Section 03300
.2 Structural steel framing: Section 05120
.3 Metal Fabrications: Section 05500

### 1.2 Reference Standards

.1 Materials, installation and workmanship to Canadian Sheet Steel Building Institute C.S.S.B.I. - Code of Practice.

.2 Structural design properties to CSA S136-(latest edition).

.3 Welding to CSA W59-(latest edition).

.4 American Society for Testing and Materials where noted.

### 1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300.

.2 Show decking plan, joints, anchorages, supports, projections, opening and reinforcement, details and accessories.

### 1.4 Design

.1 Design in accordance with CSA S136-(latest edition).

## 2. PRODUCTS

### 2.1 Materials

.1 Metal: to ASTM A446-76 Grade 'A' (230 MPa Yield) steel sheet coated with Z275 zinc coating. Deck shall be Westeel-Rosco M-38 x 0.76mm steel floor deck or approved equal.

## 3. EXECUTION

### 3.1 Fabrication

.1 Fabricate deck sections to CSA S136-(latest edition) and to depths indicated on drawings.

.2 Provide a male and female lip for each section of steel deck.

## 3.2 Erection

.1 Reinforce steel deck openings shown on the drawings unless otherwise noted.

.2 Structurally support all edges of openings cut into the deck.

.3 Install decking according to design sheet widths and depths. Correct sheet spread during installations.

.4 Button clinch sidelaps of adjacent sections at not greater than 600 mm on centre and at each end of a section, 25mm clear of the lip ends.

.5 Connect steel deck to supporting member by 20mm diameter plug welds at 300mm on centre.

.6 Make connection welds by burning through deck with welding electrode and follow by puddling in the burned hole.

.7 Weld steel decking side sections running parallel to a framing or supporting member with 20mm diameter plug welds at not greater than 750mm on centres with a weld at each end of the sections, 25mm clear of the section end.

.8 Attach metal cell closures at locations required to contain poured concrete, roof boundaries, and around openings in deck.

.9 Touch up welds with shop prime paint.

END OF SECTION

# SITE PAINTING AND FINISHING

## 1. GENERAL

### 1.1 Reference Documents

.1 Except as otherwise specified, comply with requirements of "Canadian Painting Contractors Association Architectural Painting Specification Manual" (CPCA Manual).

### 1.2 Acceptable Manufacturers

.1 Unless otherwise specified, use products manufactured by manufacturers listed in Chapert 5, Products List, of the CPCA Manual.

### 1.3 Maintenance Materials

.1 Leave on premises not less than 1L of unused material of each colour and finish sheen used on project.

.2 Tightly seal and clearly label containers.

### 1.4 Delivery

.1 Deliver materials in sealed original labelled containers bearing manufacturer's name, type of material, brand name, colour designation, and where applicable, instructions for mixing and reducing.

### 1.5 Storage

.1 Store paint and other materials at a minimum ambient temperature of 7 deg.C in a well ventilated and heated single designated area.

.2 Take precautionary measures to prevent fire hazards or spontaneous combustion.

### 1.6 Environmental Requirements

.1 Interior:

  .1 Temperature: Maintain temperature at minimum 8 deg.C for at least 24 hours before and during application and until coatings have cured after application.

.2 Ventilation: Adequately ventilate areas where coatings are being applied and maintain a reasonably dust free atmosphere.

.3 Lighting: Maintain bright and uniform levels of lighting in areas where coatings are being applied.

## 1.7 Protection

.1 Provide sufficient quantity of clean drop cloths and take necessary protective measures to prevent spray, splashing, and droppings from bouling adjacent surfaces.

.2 Remove electrical plates, surface hardware, fittings and fastenings prior to painting and finishing operations. Carefully store and replace these items on completion of work in each area.

.3 Take special care to keep sprinkler heads and smoke detectors free of paint. Replace those which do receive paint.

.4 Place cotton waste, cloths and material which may constitute a fire hazard in metal containers and remove from site daily.

## 2. PRODUCTS

## 2.1 Materials

.1 Paint and fillers: Except as otherwise specified, "top line quality" products which include "Manufacturer's List Numbers" and "Page Numbers". These numbers refer to Chapter 5, Products List, of the CPCA Manual and identify proprietary names of acceptable products.

.2 Thinners: Odourless paint thinner, pure and clean with no deleterious material.

.3 Patching compounds: Spackling compound or oil base putty for sufaces receiving a paint finish.

## 2.2 Mixing

.1 Except as otherwise specified, paints shall be ready mixed. Field mix materials in paste or powder form, or to be field-catalysed, in accordance with manufacturer's directions. Pigments shall be fully ground and shall maintain a soft paste consistency in vehicle during storage that can and shall be dispersed readily and uniformly by paddle to a complete homogeneous mixture.

.2 Thinning of materials will be permitted only where specified herein or upon Contractor's approval. Do not use solvent for thinning.

.3 Thoroughly strain all materials prior to each application.

## 2.4 Colours

.1 Colour Schedule: Colour schedule is incorporated on drawings.

## 2.3 Gloss Levels

.1 Except as otherwise specified, gloss levels for interior paint finishes shall be as follows:

  .1 Semi-gloss: In all locations.

## 3. EXECUTION

## 3.1 Examination

.1 Examine all surfaces to receive coatings.

.2 Do not apply coatings to surface whose conditions will adversely affect execution, permanence, or quality of work and which cannot be put into an acceptable condition through preparatory work specified herein.

## 3.2 Condition of Substrates

.1 Sound, non-dusting, and free of grease, oil, dirt and other matter detrimental to adhesion and appearance of coatings.

.2 Temperature: Minimum 8 deg.C.

.3 Moisture Content: Maximum 15% for wood, maximum 12% for other substrates. Test for Moisture content using electronic moisture meter.

.4 Alkalinity: Test cementitious substrates for alkalinity using litmus paper test.

3.3 Preparation of Substrates

.1 Prepare substrates in accordance with requirements of Chapter 3, Surface Preparation, of the CPCA Manual and as specified herein.

.2 All Substrates: Thoroughly broom, vacuum and wipe clean as required to produce acceptable surface. Sand lightly and dust prior to application of each coat. Use proper type and grade of sandpaper to avoid scratching or gouging of surfaces.

.3 Previously Primed Metal: Remove loose shop paint and rust; make good shop coat, feather out edges of touch-up.

.4 Zinc Coated Metal: Remove surface contaminants and wash with solvent.

.5 Unit Masonry and Concrete: Fill minor cracks, holes and fissures with cement grout and smooth to a flush surface. Include bonding agent in cement grout mix.

3.4 Application of Coatings

.1 Applied and cured coatings shall be uniform in thickness, sheen, colour, and texture and be free of defects detrimental to appearance and performance. Such defects include brush marks streaks, runs, laps, heavy stippling, pile up of paints and skipped or missed areas. Edges of paint adjoining other materials shall be clean and sharp with no overlapping.

.2 Apply paint as shown on drawing on walls and doors and metal frames including structural beams and column in Room #101, Room #102, and excluding steel deck.

.3 Apply paint and finish materials with suitable equipment.

.4 Apply paint by brush or roller, except on metal surfaces apply paint by brush only.

.5 Use rollers which will produce the least possible stipple effect; maximum 10mm pile for smooth surfaces. Heavier pile rollers may be permitted for use on rough surfaces, subject to Contractor's approval.

.6 Spray painting may be permitted where advantageous, subject to Contractor's approval. Airless spray application shall be following with back rolling.

.7 Use same brand of paint for primer, intermediate and finish coats.

.8 Vary slightly the colour of successive coats to differentiate between coats.

.9 Each coat of finish shall be dry and hard before succeeding coats are applied with a minimum of 24 hours between coats, except where manufacturer's instructions state otherwise.

### 3.7 Site Painting and Finishing Schedules

.1 Existing wood liner

  .1 IN. 5-B Alkyd Enamel Finish Semi-Gloss.

.2 Concrete Block (Painting)

  .1 IN. 7-A Alkyd Enamel Finish Semi-Gloss.

.3 Steel (Painting):

  .1 IN. 13-A Enamel Finish Semi-Gloss.

END OF SECTION

## 1. INTENT

.1 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract documents of this Division and 300 series Drawings are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructiions.

.3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

.4 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of K.E.I. at no extra cost.

.5 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors.

## 2. MATERIALS

.1 Materials and equipment installed shall be new, full weight and of quality specified. Use same brand or manufacturer for each specific application.

.2 Statically and dynamically balance rotating equipment for minimum vibration and low operating noise level.

.3 Each major component of equipment shall bear manufacturer's name, address, catalog and serial number in a conspicuous place.

## 3. METRIC CONVERSION

.1 All units in this division are expressed in SI units.

.2 Submit all shop drawings and maintenance manuals in SI units.

.3 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.

## 4. CUTTING AND PATCHING

.1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from K.E.I. before cutting or burning structural members.

.4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

## 5. SEMI-FINAL AND FINAL INSPECTIONS

.1 Perform the following items prior to semi-final inspection.
  .1 Make heating and air conditioning systems capable of operation with alarm controls functional and automatic controls in operation generally, but not necessarily finally calibrated.
  .2 Make necessary tests on equipment including those required by authorities. Obtain certificates of approval.
  .3 Rough balance air and water systems.
  .4 Complete valve tagging and identify equipment. Paint equipment, piping and install escutcheons.
  .5 Lubricate equipment as per manufacturer's data.
  .6 Mail warranty forms to manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.
  .7 Chemically clean systems. Flush and initiate water treatment. Provide report from manufacturer's representative to confirm status of treatment.
  .8 Clean fan plenums, remove temporary filters and install permanent filters.

.2 Prior to semi-final inspection, provide complete list of items which are deficient at the time of the semi-final inspection.

.3 Provide declaration in writing that deficiencies noted at time of semi-final inspection have been corrected and the following items completed prior to the final inspection:
  .1 Clean equipment both inside and out and lubricate.
  .2 Complete final balancing. Submit rough data of balance reports.
  .3 Complete final calibration.

## 6. SHOP DRAWINGS

.1 Provide shop drawings as indicated.

.2 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalog material. Do not assume applicable catalogues are available in the K.E.I.'s office. Maintenance and operating manuals are not suitable submittal material.

.3 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.

.4 Include dimensional and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes.

.5 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by K.E.I..

.6 Shop drawings not requested will not be reviewed and processed by K.E.I..

.7 Do not order equipment or material until K.E.I. has reviewed and returned shop drawing.

## 7. PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

.1 Installed mechanical equipment whose performance is questioned by K.E.I., may be subject to performance verification as specified herein.

.2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.

.3 K.E.I. will determine by whom testing shall be carried out. When requested, arrange for services of an independent testing agency.

.4 Testing procedures shall be approved by K.E.I..

.5 Maintain building comfort conditions when equipment is removed from service for testing purposes.

.6 Promptly provide K.E.I. with all test reports.

.7 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected and the following shall apply:
.1 Remove rejected equipment. Replace with equipment which meets requirements of Contract Documents including specified performance requirements.
.2 Replacement equipment will be subject to performance verification as well, using same testing procedures on originally installed equipment.
.3 SubContractor shall pay all costs resulting from performance verification procedure.

## 8. OPERATING AND MAINTENANCE DATA

.1 Instruct the building operators in the operation and preventative maintenance of each piece of equipment and system supplied and installed. Complete and turn over documentation prior to final inspection.

.2 Provide operation and maintenance data for incorporation into maintenance manual.

## 9. RECORD DRAWINGS

.1 Submit record drawings identifying location of fire dampers, major control lines, access doors, tagged valves and actual room names or numbers.

## 10. IDENTIFICATION

.1 Provide colour coding of piping and equipment.

.2 Ensure correct colour coding and identification in accordance with APWSS Colour Coding Requirements.

.3 Tag automatic controls, instruments and relays and key to control schematic on which instruments are numbered in sequence.

.4 Identify electric starting switches and remote push-button stations with 6 mm laminated plastic plates.

## 11. TEMPORARY HEAT

.1 Do not use the permanent system for temporary heating purposes without written permission from K.E.I..

.2 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged parts before final inspection.

.3 Use of permanent systems for temporary heat shall not modify terms of warranty.

.4 Operate heating systems under conditions which ensure no temporary or permanent damage. Operate fans at proper resistance with filters installed. Change filters at regular intervals. Operate with proper safety devices and controls installed and fully operational. Operate systems only with treated water as specified.

.5 Where air systems are used during temporary heating, provide filter media on return and exhaust air outlets. Clean duct systems which have become dirty.

## 12. EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out bearings and refill with new change of oil, before final aceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

## 13. TEMPORARY OR TRIAL USAGE

.1 Temporary or trial usage by K.E.I. of mechanical equipment supplied under contract shall not represent acceptance.

.2 Repair or replace permanent equipment used temporarily.

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.3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

## 14. SITE UTILITY SERVICES

.1 Maintain liaison with K.E.I. to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

## 15. ELECTRICAL MOTORS

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide motors to CEMA and CSA standards for hard, continuous service, designed to limit temperature rise to 40 C for open housing and 50 C for drip proof housing, and operate at 1200 or 1800 r/min unless otherwise specified.

.3 Motors shall have ball or roller type bearings with grease lubrication fittings.

.4 Refer to electrical specification for voltage, phase and cycle.

END OF SECTION

## 1. GENERAL

### 1.1 SCOPE

.1 Test heating water piping.

.2 Test gas piping.

.3 Test low velocity ducts.

### 1.2 QUALITY ASSURANCE

.1 Test equipment and mateial where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.

.2 Test procedures in accordance with applicable portions of ASME, ASHRAE, and other recognized test codes as far as field conditions permit.

.3 Perform tests on site before and witnessed by K.E.I..

.4 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by K.E.I.. Provide ample written notice to K.E.I. before tests.

### 1.3 SUBMITTALS

.1 Obtain certificates of approval, acceptance, and comply with rules and regulations from authorities having jurisdiction.

.2 Perform tests as specified and upon completion of mechanical installation. Provide certification of tests with detailed data as required. Itemize each test as to time performed and personnel responsible.

### 1.4 LIABILITY

.1 Take charge of plant during tests, assume responsibility for damages in event of injury to personnel, building or equipment and bear costs for liability, repairs, and restoration in this connection.

## 2. EXECUTION

### 2.1 PRESSURE TESTS

.1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments by approved laboratory or manufacturer and furnish certificate showing degree of accuracy. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.

.2 Carry out hydraulic tests for 8 hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and retest.

.3 Heating water piping: Test minimum 1 1/2 times maximum working pressure or 1030 kPa water pressure.

.4 Gas piping: Test as required by authorities having jurisdiction.

.5 Low velocity ducts: Test for tightness such that leakage is inaudible and not detectable by feel.

.6 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air or nitrogen test medium and halide torch for refrigerant medium.

.7 During heating and cooling piping system tests, check linear expansion at elbows, U-bends, expansion joints, and offsets for proper clearance.

.8 When using water as test medium for system not using water or steam, evacuate and dehydrate the piping and certify the lines are dry. Use agency specializing in this type of work.

.9 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by remaking joints in screwed fittings, cutting out and re-welding welded joints, remaking joints in copper lines. Do not caulk.

### 2.2 PERFORMANCE TESTS

.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes,

.1 (Cont'd)
repairs, adjustments, and replacements required as tests may indicate prior to operating tests.

.2 Make operating tests for minimum of 2 days during heating season [and cooling season] of first year of operation, and at times when directed, for proper settings of controls under peak load conditions.

.3 Conduct final operating tests in presence of K.E.I.. Vary loads to illustrate start-up and shut-down, sequence, and simulate emergency conditions for safety shut-downs, with automatic and manual reset. Repair and test defects until satisfactory. Make final adjustments to suit exact building conditions.

.4 Provide services of one job mechanic, ladders, tools and associated equipment required to assist K.E.I. in final tests.

.5 Lubricate bearings, adjust and/or replace and set direct and "V" belt drives for proper alignment and tension.

.6 Calibrate and adjust thermostats, thermometers, gauges, linkage and dampers. Control valves shall operate freely.

.7 Operate and test motors and speed switches for correct wiring and sequences. Check overload heaters in motor starters.

.8 Replace and clean filters. Clean fan wheel and coils.

.9 Remove and clean strainers.

.10 Fasten loose and rattling pieces of equipment. Unit heaters, pumps and other equipment shall operate quietly.

END OF SECTION

--------------------------- END ---------------------------

# 1. GENERAL

## 1.1 SCOPE

.1 Balance, adjust and test air systems and equipment, and submit reports as specified.

.2 Balance, adjust and test water systems and equipment, and submit reports in SI units.

## 1.2 QUALITY ASSURANCE

.1 Testing and balancing shall be performed by an agency that specializes in this type of work.

.2 Procedures, in general, shall be in accordance with Associated Air Balance Council National Standards for Field Measurement and Instrumentation - Total System Balance.

.3 Provide extended warranty of 90 days after completion of test and balance work. During this period K.E.I. may request recheck, or resetting of outlets or fans as listed in test report. Provide technicians and instruments required.

.4 Begin testing and balancing after systems has been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of testing and balancing.

## 1.3 BALANCING AGENDA

.1 General: Prior to commencement of balancing review verbally with K.E.I. method and instruments to be used in balancing. Discussion shall include descriptive data, procedure data, and sample forms.

.2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed.

## 1.4 BALANCE REPORT

.1 Submit copies of reports described to K.E.I. prior to final acceptance of project.

## 1.5 SYSTEM DATA

.1 Reports shall include balance and equipment data listed.

.2 Air Handling Equipment Installation Data:

Manufacturer and model;
Size;
Arrangement discharge and class;
Motor type, kW, r/min, voltage, phase, cycle and running full load amperage;
Location and local identification data.

.3 Air Handling Equipment Design Data:

Total air flow rate;
Static pressure;
Motor kW, r/min and amps;
Outside air flow rate L/s;
Fan r/min;
Fan kW;
Inlet and outlet, dry and wet bulb temperatures.

.4 Air Handling Equipment Recorded Data:

Air flow rate;
Static pressure;
Fan r/min;
Motor operating amperage;
Inlet and outlet, dry and wet bulb temperatures.

.5 Duct Air Quantities - Mains, Branch, Outside Air and Exhaust (Maximum and Minimum):

Duct sizes;
Number of pressure readings;
Sum of velocity measurements;
Average velocity;
Duct recorded air flow rate;
Duct design air flow rate.

.6 Air Inlets and Outlets:

.6 Air Inlets and Outlets:(Cont'd)

Outlet Identification Location and Designation;
Manufacturers catalogue identification and type;
Application factors;
Design and recorded velocities;
Design and recorded air flow rates;
Deflector vane or diffuser cone settings.

## 2. PRODUCTS

### 2.1 INSTRUMENTS

.1 Use accurate instruments for measurement.

.2 Provide calibration histories for each instrument. Recalibration or use of other instruments may be requested when accuracy of reading is questionable.

## 3. EXECUTION

### 3.1 GENERAL PROCEDURE

.1 Balance to maximum measured flow deviation of 10% or mean sound level deviation of 20 db from specified values.

.2 Permanently mark settings on valves, splitters, dampers and other adjustment devices.

.3 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.4 At final inspection, recheck random seletions of data recorded in report. Recheck points or areas as selected and witnessed by K.E.I..

### 3.2 AIR SYSTEM PROCEDURE

.1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

.2 Make air quantity mesurements in ducts by "Pitot Tube" traverse of entire cross-sectional area of duct.

.3 Meaure air quantities at each air inlet and outlet.

.4 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.

.5 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.6 Where modulating dampers are provided, take measurements and balance at extreme conditions.

END OF SECTION

END

## 1. GENERAL

### 1.1 SCOPE

.1 Includes piping within and to 2.5 m beyond the building, as follows:

.2 Sanitary drainage and vent.

.3 Natural gas.

.4 Hot water heating.

.5 Domestic water.

.6 Refrigerant.

### 1.2 WELDING

.1 Welding materials and labour must conform to ASME Code and the Provincial Board of Labour Legislation.

.2 Use welders fully qualified and Licensed by Provincial Authorities.

.3 Use B pressure welders for contained pressures in excess of 100 kPa.

### 1.3 QUALITY ASSURANCE

.1 Gas piping: National Standard of Canada CAN1-B149.1-M80, Installation Code for Natural Gas Burning Appliances and Equipment.

.2 Domestic water, drainage and vent piping: ABC 1981.

.3 Copper pipe, direct connections: UL approval; brazing in accordance with Copper Development Association Copper Tube Handbook.

## 2. PRODUCTS

## 2.1 PIPE

| | Service | Material |
|---|---|---|
| .1 | Hot water heating to 121 deg. C. | Steel Schedule 40, black. |
| .2 | Refrigerant | ACR Copper |
| .3 | Sanitary Drainage & Vent above grade | Type "M" or "DMV" Copper. |
| .4 | Domestic Water unburied | Type L hard copper - 50mm & over, Type M - 38mm & under |

## 2.2 FITTINGS

| | Service | Material | Joint |
|---|---|---|---|
| .1 | Hot water heating to 121 deg. C | Malleable iron 1034 kPa banded | Threaded |
| | | Steel same thickness as pipe | Welded |
| .2 | Natural Gas | Malleable iron 1034 kPa banded, air tested, for pipe sizes 51mm & under. | Threaded |
| | | Steel same thickness as pipe for sizes 51 mm and over | Welded |
| .3 | Refrigerant | Wrought copper, | Brazed, Phos-copper alloy |
| | | Forged Brass | Brazed, silver alloy |
| .4 | Sanitary drainage & Vent Unburied | Wrought copper or cast brass. | 50-50 solder |
| .5 | Domestic water inside building | Wrought copper, bronze or cast brass. | 95-5 solder |

.6 Use factory fabricated butt weld fittings for welded steel pipes.

.7 Use long radius elbows for steel piping.

## 3. EXECUTION

### 3.1 PREPARATION

.1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

### 3.2 CONNECTIONS

.1 Screw joint steel piping up to and including 40 mm. Weld piping 65 mm and larger including branch connections. Screw or weld 50 mm piping.

.2 Make screwed joints with full cut standard taper pipe threads with approved non-toxic joint compound applied to male threads only.

.3 Use main sized saddle type branch connections.

.4 Make connections to equipment and branch mains with unions.

.5 Provide non-conducting type connections wherever jointing dissimilar metals. Brass adaptors and valves are acceptable.

### 3.3 ROUTE AND GRADES

.1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furrings to a minimum.

.2 Slope water piping at 0.2% and arrange to drain at low points.

.3 On closed systems, equip low points with 20 mm drain valves and hose nipples. Provide, at high points on lines and on equipment connections, collecting chambers and high capacity float operated automatic air vents.

### 3.4 INSTALLATION

.1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.

.2 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.

.3 Yellow jacket buried gas lines; prime coat and paint lines exposed to outdoors.

END OF SECTION

---------------------------- END ---------------------------------

## 1. GENERAL

### 1.1 SCOPE

.1 Pipe hangers and supports.

.2 Duct hangers and supports.

.3 Flashing for mechanical equipment.

.4 Sleeving for mechanical equipment.

### 1.2 REFERENCE STANDARDS

.1 Pipe supports shall meet the requirements of ANSI B31.1, power piping.

.2 Duct hangers shall follow the recommendations of the SMACNA Duct Manuals.

### 1.3 GENERAL REQUIREMENTS

.1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.

.2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.

.3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.

.4 Fasten hangers and supports to building steel or inserts in concrete construction.

.5 Provide and set sleeves required for equipment, including openings required for placing equipment.

.6 Dielectrically isolate dissimilar metals.

## 1.4 ALTERNATIVES

.1 Obtain approval from K.E.I. prior to drilling for inserts and supports for piping systems.

.2 Obtain approval from K.E.I. prior to using percussion type fastenings.

.3 Use of existing piping or equipment for hanger supports is not permitted.

.4 Use of perforated band iron, wire or chain as hangers is not permitted.

## 2. PRODUCTS

## 2.1 INSERTS

.1 Inserts shall be malleable iron case or [galvanized] steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.

.2 Size inserts to suit threaded hanger rods.

## 2.2 PIPE HANGERS AND SUPPORTS

.1 Hangers: Pipe sizes 15 mm to 40 mm: Adjustable wrought steel ring.

.2 Hangers: Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes 150 mm Over: Adjustable wrought steel clevis.

.3 Wall Support: Pipe Sizes to 80 mm: Cast iron hook.

.4 Vertical Support: Steel riser clamp.

.5 Floor Support: Pipe Sizes to 100 mm and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.

.6 Design hangers so they cannot become disengaged by movements of supported pipe.

.7 Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping.

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## 2.3 HANGER RODS

.1 Provide steel hanger rods, threaded both ends, threaded one end, or continuous threaded.

## 2.4 DUCT HANGERS AND SUPPORTS

.1 Hangers: Galvanized steel band iron or rolled angle and 10 mm rods.

.2 Wall Supports: Galvanized steel band iron or fabricated angle bracket.

.3 Vertical Support at Floor: Rolled angle.

## 2.5 FLASHING

.1 Steel Flashing: 0.55 mm galvanized steel.

.2 Lead Flashing: 25 kg/m sheet lead for waterproofing, 5 kg/m sheet lead for soundproofing.

.3 Safes: 25 kg/m sheet lead or 200 micrometre neoprene.

.4 Caps: Steel, 0.7 mm thickness minimum, 1.6 mm thickness at fire resistance structures.

## 2.6 SLEEVES

.1 Pipes through Beams, Walls, Fire Proofing, Footings, Poetntially Wet Floor: Form with steel pipe or 1.2 mm thickness galvanized steel.

.2 Round Ducts: Form sleeves with galvanized steel.

.3 Rectangular Ducts: Form sleeves with galvanized steel or wood.

.4 Size large enough to allow for expansion with continuous insulation.

## 2.7 FINISHES ON HANGER RODS, HANGERS AND SUPPORTS

.1 All steel hanger rods, hangers and supports shall bc galvanized or factory primed.

## 3. EXECUTION

### 3.1 PIPE HANGERS AND SUPPORTS

.1 Install hangers to provide minimum 12 mm clear space between finished covering and adjacent work.

.2 Place a hanger within 300 mm of each horizontal elbow.

.3 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.

.4 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.5 Where practical, support riser piping independently of connected horizontal piping.

### 3.2 LOW VELOCITY DUCT HANGERS AND SUPPORTS

.1 Hanger Minimum Sizes:
  .1 Up to 750 mm wide: 25 x 1.6 mm at 3 m spacing.
  .2 790 to 1200 mm wide: 40 x 1.6 mm at 3 m spacing.
  .3 Over 1200 mm wide: 40 x 1.6 mm at 2.4 m spacing.

.2 Horizontal Duct on Wall Supports Minimum Sizes:
  .1 Up to 450 mm wide: 40 x 1.6 mm or 25 x 25 x 3 mm at 2.4 m spacing.
  .2 480 x 1000 mm wide: 40 x 40 x 3 mm at 1.2 m spacing.

.3 Vertical Duct on Wall Supports Minimum Sizes at 3.65 m spacing:
  .1 Up to 610 mm wide: 40 x 1.6 mm.
  .2 640 to 900 mm wide: 25 x 25 x 3 mm.
  .3 Over 1520 mm wide: 50 x 3 mm.
  .4 940 to 1200 mm wide: 30 x 30 x 3 mm.

.4 Vertical Duct Floor Supports Minimum Sizes, riveted or screwed to ducts:
  .1 Up to 1520 mm wide: 40 x 40 x 3 mm.
  .2 Over 1520 mm wide: 50 x 3 mm.

### 3.3 EQUIPMENT SUPPORTS

.1 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

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.2 Rigidly anchor ducts and pipes immediately after vibration connections to equipment.

## 3.4 FLASHING

.1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.

.2 Provide curbs for mechanical roof installations minimum 200 mm high. Flash and counterflash with steel; solder and make waterproof.

## 3.5 SLEEVES

.1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

.2 Where piping or ductwork passes through floor, ceiling or wall, close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

END OF SECTION

-------------------------- END --------------------------

## 1. GENERAL

### 1.1 SCOPE

.1 Gate valves.

.2 Plug cocks.

### 1.2 MANUFACTURER

.1 Provide valves of same manufacturer throughout where possible.

.2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

### 1.3 SHOP DRAWINGS

.1 Submit detailed shop drawings. Shop drawings shall clearly indicate make, model, location, type, size and pressure rating.

## 2. PRODUCTS

### 2.1 VALVE CONNECTIONS

.1 Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.

.2 Thread pipe sizes 50 mm and smaller.

.3 Solder or screw to solder adaptors for copper tubing.

### 2.2 GATE VALVES

.1 Bronze body, rising bronze stem, inside screw, double wedge or disc, solder or screwed ends.

.2 Iron body, bronze trim, rising stem, O.S. & Y., solid wedge, flanged ends.

.3 [2070 kPa] WSP, forged steel body, stainless steel wedge, stellite seat rings, rising stem, O.S. & Y., bolted bonnet, screwed ends.

.4 [2070 kPa] WSP, cast steel body, wedge disc, chromium stainless steel trim, rising stem, C.S. & Y., bolted bonnet, flanged ends.

## 2.3 PLUG COCKS

.1 Iron body, brass plugs and washers, air tested, solder or screwed ends.

.2 Iron body and plug, pressure lubricated type, flanged ends.

## 2.4 PRESSURE RATINGS

.1 Unless otherwise indicated, use valves suitable for minimum [860 kPa] WSP at [232 C] and [1380 kPa] WOG at [121 C].

## 2.5 VALVE OPERATORS

.1 Provide suitable handwheels for gate and drain valves.

## 3. EXECUTION

## 3.1 INSTALLATION AND APPLICATION

.1 Install valves with stems upright or horizontal, not inverted.

.2 Install gate valves for shut-off and isolating service, to isolate equipment, part of systems or vertical risers.

.3 Use plug cocks for gas service.

.4 Provide drain valves at main shut-off valves, low points of piping and apparatus.

END OF SECTION

------------------------- END -------------------------

# 1. GENERAL

## 1.1 SCOPE

.1 Provide piping insulation.

.2 Provide adhesive, tie wires, tapes.

.3 Provide recovering.

## 1.2 QUALITY ASSURANCE

.1 Have insulation installed by skilled workmen regularly engaged in this type of work.

.2 Materials shall meet fire and smoke hazard ratings as stated in this Section and defined in Alberta Heating Ventilating & Air Conditioning Code.

## 1.3 SUBMITTALS

.1 Submit as requested by K.E.I. samples of proposed insulating materials.

## 1.4 JOB CONDITIONS

.1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesvie manufacture. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

## 1.5 . ALTERNATIVES

.1 Alternative insulations are subject to approval. Alternatives shall provide the same thermal resistance within 10%, at normal conditions as materials specified.

## 1. GENERAL

## 2. PRODUCTS

### 2.1 GENERAL

.1 Adhesives Insulation Materials & Recovery Jackets: Composite fire and smoke hazard ratings shall not exceed 25 for Flame Spread and 50 for Smoke Developed. Adhesives shall be waterproof.

### 2.2 MATERIALS

.1 Cold Piping: Fine fibrous glass insulation, with factory applied vapour barrier jacket, molded to conform to piping, "K" value at [24 C] maximum [ 0.035 W/m. C].

.2 Hot Piping: Fine fibrous glass insulation with factory applied general purpose jacket, molded to conform to piping, "K" value at [24 C] maximum [0.035 W/m. C].

.3 Refrigerant Piping: Foamed plastic of closed cell structure, "K" value at [24 C] maximum [0.04 W/m. C] maximum water vapour transmission rating of 0.1 perms.

.4 Recovery Jacket: ULC labelled thermo-canvas flame spread less than 25, smoke developed less than 50.

## 3. EXECUTION

### 3.1 PREPARATION

.1 Do not install covering before piping and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

### 3.2 INSTALLATION

.1 Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation materials, properly sealed.

## 1. GENERAL

.2 Insulate fittings and valves. Do not insulate unions, flanges, strainers.Do not insulate flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

.3 Finish insulation neatly at hangers, supports and other protrusions.

.4 Locate insulation or cover seams in least visible locations.

.5 Provide recovering jackets on exposed insulation throughout. Use pre-sized paper under recovering at uneven insulated surfaces.

.6 Cover insulation exposed to outdoors with metal jacket. Paint & seal.

.7 Cold Piping: Cover fittings and valves with equivalent thickness of insulation material. Cover with open mesh glass cloth sealed with vapour barrier sealant. Seal lap joints with 100% coverage of vapour barrier sealant and adhesive. Seal butt joints with 100 mm wide strips or vapour barrier sealed with vapour barrier adhesive. For exposed fittings and valves, apply, hydraulic setting cement paste over insulation material before applying recovering.

.8 Hot Piping: Cover fittings and valves with equivalent thickness of insulation material. Recover. For exposed fittings and valves apply hydraulic setting cement paste over insulating material before apply recovering.

.9 Refrigerant Piping: Cover fittings and valves with equivalent thickness of insulation material. Apply with edges tightly butted. Seal joints with vapour barrier tape or sealer.

## 3.3 INSULATION THICKNESS SCHEDULE

| | | Pipe Sizes | Insulation Thickness mm |
|---|---|---|---|
| .1 | Domestic Cold Water Piping | All Sizes Up to 50 mm | 12 |
| .2 | Glycol Heating Piping | All Sizes Up to 20 mm | 12 |

## 1. GENERAL

| | | | |
|---|---|---|---|
| .2 | (Cont'd) | | |
| | | 25 to 200 mm | 25 |
| .3 | Refrigerant Suction, Liquid, Piping | All Sizes | 25 |

END OF SECTION

END

# 1. GENERAL

## 1.1 SCOPE

.1 Duct thermal insulation.

.2 Adhesive, tie wires, tapes.

.3 Recovery.

## 1.2 QUALITY ASSURANCE

.1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.

.2 Materials shall meet fire & smoke hazard ratings as stated in this section & defined in Alberta Heating Ventilating & Air Conditioning Code.

## 1.3 SUBMITTALS

.1 Submit samples of proposed insulating materials, to K.E.I. as requested.

## 1.4 JOB CONDITIONS

.1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacture. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

## 1.5 ALTERNATIVES

.1 Alternative insulations are subject to approval. Alternatives shall provide the same thermal resistance within 10%, at normal conditions as material specified.

## 2. PRODUCTS

### 2.1 GENERAL

.1 Adhesive and Insulation Materials: Composite fire and smoke hazard ratings shall not exceed 25 for Flame Spread and 50 for Smoke Developed. Adhesives shall be waterproof.

.2 Recovery Jackets: to have flame spread rating not exceeding 25 and smoke developed classification of not more than 50, as supplied by S. Fattal Cotton Inc.

### 2.2 MATERIALS

.1 Exposed Rectangular Ducts: Rigid fibrous glass insulation, "K" value at [24 deg.C] maximum [0.036 W/m.deg.C] with factory applied reinforced aluminum foil vapour barrier.

.2 Recovery Jacket: ULC labelled thermo-canvas with flame spread less than 25 smoke developed less than 50, as supplied by S. Fattal Cotton Inc.

## 3. EXECUTION

### 3.1 PREPARATION

.1 Do not install covering before ductwork and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

### 3.2 INSTALLATION

.1 Finish insulation neatly at hangers, supports and other protrusions.

.2 Locate insulation or cover seams in least visible locations.

.3 Cover insulation exposed to outdoors with suitable metal jacket.

.6 Exposed Rectangular Ducts: Secure rigid insulation with 50% coverage of adhesive and [2.7 mm] [12 gauge] galvanized impale anchor tabs on [400 mm]. Do not insulate supply duct inside building.

## 3.3 INSULATION THICKNESS SCHEDULE

| | | Insulation Thickness | |
|---|---|---|---|
| | Duct and Equipment | (mm) | (in) |
| .1 | Exhaust Ducts within [3 m] [10'] of Exterior Walls or Openings for from Fan Discharge (whichever is least) | [25] | |
| .2 | Incinerator Breeching | [50] | [2] |
| .3 | Rectangular Supply Ducts | [25] | [1] |

END OF SECTION

---------------------------- END ------------------------------

## 1. GENERAL

### 1.1 SCOPE

.1 Directfired make-up air heater.

.2 Filter section.

.3 Controls.

### 1.2 QUALITY ASSURANCE

.1 Comply with local and Provincial Regulations and have CSA approval.

.2 Factory test to check construction, controls and operation of unit and provide certification.

.3 Operationally test after installation.

## 2. PRODUCTS

### 2.1 GENERAL CONSTRUCTION

.1 Construct heater casing and components of 1.3mm steel panels, reinforced with structural angles and channels to ensure rigidity under normal handling. Provide access panels to burner and blower motor assemblies from either side of unit.

.2 Locate observation port on burner section for observing main and pilot flames.

.3 Insulate complete unit with 25mm neoprene faced fibrous glass insulation.

.4 Finish casing and components with heat resistant baked enamel.

.5 For outdoor installation, provide weatherproofed casing with intake and hood.

## 2.2 FILTERS

.1 Provide filter section complete with removable 50mm thick fibrous glass disposable] filters in metal frames.

## 2.3 BURNER

.1 Provide raw gas burner suitable for natural gas and capable of modulating turn down ration of 25:1. Burner assembly and gas piping arrangement to include electric modulating main gas valve, motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shut-off valve, and pilot adjustment valve.

.2 Furnish gas burner with electrically ignited supervised pilot. Pilot automatically ignited by spark rod through high voltage ignition transformer.

.3 Provide motorized damper complete with end switch to prove position before burner will fire.

## 2.4 FAN

.1 Provide statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy duty self-aligning pre-lubricated ball bearings and V-belt drive with matching motor sheaves and belts.

## 2.5 CONTROLS

.1 Pre-wire unit completely so connection of power supply and field wiring from unit to remote control panel shall make unit operative.

.2 Control panel shall contain on-off switch, [summer-winter switch], indicating lights for supply fan, burner operation.

.3 Interlock unit to start when exhaust fan is running. Interlock burner to operate when flow switch located in exhaust duct proves flow. Interlock exhaust fans to inlet damper and burner profile damper to provide dual volume operation. Unit shall also contain an auxiliary unit air proving switch c/w terminal.

.4 Fan discharge thermostat shall control modulating gas valve to maintain supply air temperature.

.5 Provide safety controls to provide correct air flow before energizing pilot and to sense pilot ignition before activating main gas valve.

.6 Provide manual reset low and high limit controls to maintain supply air temperature between set points and shut fan down if temperature are exceeded.

.7 Provide purge period timer to delay burner ignition and automatically bypass low limit control.

.8 Electrical Requirements.
- controls enclosure to be EEMAC 4 rated, suitable for outdoor installation
- starter to be size 1, 600V, 3ph., 60 cycle
- complete with 350VA, 600/120V control transformer
- start/stop push button
- 3 pole overload relay
- combination circuit breaker starter
- 1 normally open, 1 normally closed, auxiliary contacts
- all wiring to be brought to a terminal block for auxiliary wiring
- minimum number of outgoing terminals - 6
- refer to electrical drawings for wiring diagrams
- ambient temperature -40 deg.C to +40 deg.C
- subcontractor shall provide electrical schematic as per the drawing 401 as minimum. However, if he has to incorporate additional controls to ensure his equipment performance he shall prepare a combined information drawing and submit for Kilborn review.

## 3. EXECUTION

### 3.1 PERFORMANCE

.1 Provide dual volume outdoor unit with 21 deg.C delivery temperature based on 61 deg.C temperature rise of 4720 L/s at 125 kPa external static pressure with 5.59 kW motor.

END OF SECTION

# 1. GENERAL

## 1.1 SCOPE

.1 Ductwork and plenums.

.2 Fasteners.

.3 Sealants.

.4 Duct cleaning.

## 1.2 DEFINITIONS

.1 Low Pressure: Static pressure in duct less than [0.5 kPa] and velocities less than [10 m/s].

.3 Duct Sizes: Inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

## 1.3 QUALITY ASSURANCE

.1 Ductwork shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems [, NFPA No. 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems] [and NFPA No. 96, Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapours from Commercial Cooking Equipment].

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks.

## 1.4 ALTERNATIVES

.1 Size round ducts installed in place of rectangular ducts indicated from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration of sizes permitted except by written permission.

## 2. PRODUCTS

### 2.1 MATERIALS

.1 Ducts: Galvanized steel lock forming quality, having galvanized coating to ASTM A525 G90 designation for both sides.

.2 Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

.3 Sealant: Water resistant, fire resistive, compatible with mating materials.

### 2.2 FABRICATION

.1 Complete metal ducts with themselves with no single partition between ducts. Where width of duct exceeds [450 mm] cross break for rigidity. Open corners are not acceptable.

.2 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.3 Construct tees, bends, and elbows with radius of not less than 1 1/2 times width of duct on centre line. Where not possible and where rectangular elbows used, provide approved type air foil turning vanes. Where acoustical lining is provided, provide turning vanes of perforated metal type with fibreglass inside.

.4 Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible. Maximum divergence upstream of equipment to be 30 degree and 45 degree convergence downstream.

.5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

.6 Provide easements where low pressure ductwork conflicts with piping and structure where easements exceed 10% duct area, split into two ducts maintaining original duct area.

## 3. EXECUTION

### 3.1 INSTALLATION

.1 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pivot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.2 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.

.3 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

### 3.2 LOW PRESSURE DUCT [THICKNESSES] [GAUGES] (MINIMUM)

.1 Rectangular Ducts

| Maximum Width | [mm] | [Galv. Gauge] |
|---|---|---|
| Up to [300 mm] [12"] | [0.6] | [26] |
| [330 mm to 760 mm] [13" to 30"] | [0.8] | [24] |
| [790 mm to 1370 mm] [31" to 54"] | [0.8] | [22] |
| [1400 mm to 2130 mm][55" to 84"] | [1.0] | [20] |
| [2160 mm] [85"] and Over | [1.2] | [18] |

.2 Round Ducts

| Duct Diameter | [mm] | [Galv. Gauge] |
|---|---|---|
| Up to [330 mm] [13"] | [0.6] | [26] |
| [350 mm to 550 mm] [14" to 22"] | [0.8] | [24] |
| [580 mm to 1270 mm][23" to 36"] | [0.8] | [22] |
| [890 mm to 910 mm] [37" to 50"] | [1.0] | [20] |
| [1300 mm to 1520 mm][51" to 60"] | [1.2] | [18] |
| [1550 mm to 2130 mm][61" to 84"] | [1.6] | [16] |

END OF SECTION

---------------------------- END --------------------------------

# 1. GENERAL

## 1.1 SCOPE

.1 Access Doors.

.2 Fire Dampers.

.3 Balancing Dampers.

.4 Backdraft Dampers.

.5 Flexible Connections.

## 1.2 QUALITY ASSURANCE

.1 Fire dampers shall be UL listed and constructed in accordance with ULC Standard S 112 "Fire dampers".

.2 Fusible links on fire dampers shall be constructed to ULC Standard S 505.

.3 Demonstrate resetting of fire dampers to authorities having jurisdiction and Owner's representative.

.4 Access doors shall be UL labelled.

.5 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems.

.6 Fabricate in accordance with ASHRAE handbooks and SMACNA duct manuals.

## 1.3 SUBMITTALS

.1 Submit shop drawings of factory fabricated assemblies.

.2 Submit samples of shop fabricated assemblies as requested.

# 2. PRODUCTS

## 2.1 ACCESS DOORS

.1 Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices. Install minimum [25 mm] thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricate with two butt hinges and two sash locks for sizes up to [450 mm], two hinges and two compression latches with outside and inside handles for sizes up to [600 x 1200 mm] and an additional hinge for larger sizes.

## 2.2 FIRE DAMPERS

.1 Fabricate of galvanized steel or prime coated black steel weighted to close and lock in closed position when released by fusible link.

.2 Curtain type fire dampers shall have blades retained in a recess so free area of connecting ductwork is not reduced.

.3 Fusible links shall be set for [72 C].

## 2.3 DAMPERS

.1 Fabricate of galvanized steel, minimum [1.6 mm] and provide with quadrants or adjustment rod and lock screw.

.2 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration. Size on basis of straight air volume proportioning.

.3 Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes [300 x 1800 mm]. Assemble center and edge crimped blade in prime coated or galvanized channel frame with approved type hardware.

.4 Fabricate multi-blade, parallel action gravity balanced backdraft dampers with blades a maximum of [150 mm] width having felt or flexible vinyl sealing edges, linked together in rattle-free manner and with adjustment device to permit setting for varying differential static pressure.

## 2.4 FLEXIBLE CONNECTIONS

.1 Fabricate of approved neoprene coated flameproof fabric approximately [50 mm] wide tightly crimped into metal edging strip and attach to ducting and equipment by screws or bolts at [150 mm] intervals.

## 3. EXECUTION

## 3.1 APPLICATION

.1 Provide adequately sized access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Review locations prior to fabrication.

.2 Provie [100 x 100 mm] quick opening access doors for inspection at balancing dampers.

.3 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings, and hinges.

.4 At each point where ducts pass through partitions, the joints around the duct shall be sealed with non-combustible material.

.5 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger duct as required for proper air balancing.

.6 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and where indicated on the drawings.

END OF SECTION

--------------------------- END ---------------------------

# IMPROVEMENTS TO THE HEAVY OIL MINI-PLANT RESEARCH FACILITY

## APPENDIX "B"

## MECHANICAL DATA BOOK FOR EQUIPMENT

by KILBORN ENERGY INC.

DSS FILE #04SO.23440-6-90194

116 pp

# IMPROVEMENTS TO THE HEAVY OIL
# MINI-PLANT RESEARCH FACILITY

## APPENDIX "B"
## MECHANICAL DATA BOOK FOR EQUIPMENT

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SECTION 2 ENG AIR HE SERIES DIRECT FIRED MVA UNIT
- SERVICE MANUAL
- VENDOR PRINTS
- HONEYWELL GAS VALVE ACTUATOR

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- VENDOR PRINT

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- MAINTENANCE INSTRUCTIONS
- DIMENSIONAL & PERFORMANCE DATA

SECTION 5 ACME EXHAUST FAN DATA SHEET

SECTION 6 CONTROL COMPONENTS AND MISC.
- DAMPERS
- MODULATORS
- HONEYWELL PROPORTIONING TEMPERATURE CONTROLLER
- SUPPLY AND RETURN GRILLS
- DIFFUSERS
- ALLEN BRADLEY SWITCH INSTALLATION

# Devon Coal Research Centre
# Field Research Maintenance Building
# AIR BALANCE REPORT

**Alltec BALANCING**

a division of the *naramata development corporation*
ALLTEC BALANCING, Main P.O. Box #11806, Edmonton, Alberta T5J 3K9

March 1988

AIR BALANCE REPORT

PROJECT Devon Coal - Field Research Maintenance Bldg.
CONTRACTOR Gen-Air Ventilation Ltd.
ENGINEER Kilborn Energy Inc.

COMMENTS

The make-up air fan was measured for total air volume delivery by the summation of the outlets since a duct traverse could not be taken due to lack of straight duct-work. The capacity of the unit is slightly over the design air volume.

The two exhaust fans were adjusted for different fan rpm to acheive the required air volumes. EF-1 having the ductwork required slightly higher fan speed to acheive the same air volume as EF-2.

The capacity of the make-up air fan during high speed had to be simulated by adjusting the motorized damper in the ductwork to fully open and by adjusting the internal unit motorized damper to fully open since the control section was not yet completed.

The office and airlock room are presently at 0.06" or 15 pascals positive pressure during normal operation.

Please refer to the enclosed sheets and the sketch for details of this air balance report.

Yours truly,
ALLTEC BALANCING

Jerry Kleinow

**Altec BALANCING**
a division of the naramata development corporation

Date March/88

Page 1 of 5

Project Name Devon Coal Research Centre-Field Research Maintenance Building

# AIR MOVING EQUIPMENT TEST SHEET

| | | |
|---|---|---|
| SYSTEM | V-1 | |
| Equipment Location | south exterior of building | |
| Area Served | entire building | |
| Equipment Manufacturer | Engineered Air | |
| Model | HE-100-0 | |
| Serial Number | 13435 | |

| | Specified | Actual | Specified | Actual |
|---|---|---|---|---|
| Total l/s - Fan | 4720/2360 | 5056/2510 | | |
| Total l/s - Outlet | 4720/2360 | 5056/2510 | | |
| R/A l/s | - | - | | |
| O/A l/s | 4720/2360 | 5056/2510 | | |
| Total Static Pressure (Total/External) | 125 pa | 90 pa esp | | |
| Inlet Pressure | - | 90 pa esp | | |
| Discharge Pressure | - | 0 pa esp | | |
| Fan RPM | - | 770 | | |

| | Specified | Actual | Specified | Actual |
|---|---|---|---|---|
| Motor Manufacturer | - | Leroy Somer | | |
| Motor kW. | 5.595 | 5.595 | | |
| Phase | 3 | 3 | | |
| Voltage | 575 | 600 | | |
| Amperage | 8.2 | 6.2/6.4/6.5 | | |
| Motor RPM | 1740 | 1770 | | |
| Motor Service Factor | - | 1.15 | | |
| Starter Heater Elements | - | - | | |

| | | |
|---|---|---|
| Motor Sheave & No Grooves | 1 3/8" x 5 3/4" fixed 2V | |
| Fan Sheave & No Grooves | 1" x 12 3/4" fixed 2V | |
| Belts | B-73 | |

Remarks

Alltec BALANCING
a division of the naramata development corporation

Date March/88

Page 2 of 5

Project Name Devon Coal Research Centre-Field Research Maintenance Building

# EXHAUST FAN DATA SHEET

| SYSTEM | EF-1 | EF-2 |
|---|---|---|
| Equipment Location | rooftop | rooftop |
| Area Served | high & low level of bldg. | high level exhaust |
| Equipment Manufacturer | ACME Centrimaster | ACME Centrimaster |
| Model | PU 300H | PU 300H |
| Serial Number | PMA030110 | PMA030110 |

| | Specified | Actual | Specified | Actual |
|---|---|---|---|---|
| Total l/s - Fan | 2340 | 2486 | 2340 | 2410 |
| Total l/s - Outlet | 2340 | 2486 | 2340 | 2410 |
| Total Static Pressure* (Total/External) | 35 pa | - | 35 pa | - |
| *Inlet Pressure | - | 30 pa | - | 12 pa |
| *Discharge Pressure | - | atmosphere | - | atmosphere |
| Fan RPM | - | 545 | - | 505 |

| | Specified | Actual | Specified | Actual |
|---|---|---|---|---|
| Motor Manufacturer | - | Leeson | - | Leeson |
| Motor kw. | 0.5595 | 0.5595 | 0.5595 | 0.5595 |
| Phase | 3 | 3 | 3 | 3 |
| Voltage | 575 | 600 | 575 | 600 |
| Amperage | 1.1 | 0.8/0.7/0.6 | 1.1 | 0.8/0.7/0.6 |
| Motor RPM | 1725 | 1735 | 1725 | 1735 |
| Motor Service Factor | - | 1.0 | - | 1.0 |
| Starter Heater Elements | - | 1.18 Amps | - | 1.18 Amps |

| | | |
|---|---|---|
| Motor Sheave & No Grooves | 5/8" x 3 1/4" near max. 1V | 5/8" x 3 1/4" near max. 1V |
| Fan Sheave & No. Grooves | 1" x 9 1/4" fixed 1V | 1" x 9 1/4" fixed 1V |
| Belts | A-38 | A-38 |

*Not always required or applicable.

Remarks

Alltec BALANCING

# AIR DISTRIBUTION TEST SHEET

SYSTEM V-1 DATE March/88 PAGE 3 of 5

| # | LOCATION | TYPE | SIZE | AK | DESIGN m/s | DESIGN l/s | BOX | TEST | MEASURED m/s | MEASURED l/s |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | office | RCDA | 150 Ø | 11.15 | 4.04 | 45 | - | - | 4.3 | 48 |
| 2 | " | " | 250 Ø | 29.73 | 4.71 | 140 | - | - | 4.6 | 137 |
| 3 | building | 12 | 600x300 | 151.87 | 2.37 | 360 | - | - | 2.6 | 395 |
| 4 | " | " | " | " | " | " | - | - | 2.5 | 380 |
| 5 | " | " | " | " | " | " | - | - | 2.5 | 380 |
| 6 | " | " | " | " | " | " | - | - | 2.6 | 395 |
| 7 | " | " | " | " | " | " | - | - | 2.5 | 380 |
| 8 | " | " | " | " | " | " | - | - | 2.6 | 395 |
| 9 | motorized damper | screen | 600x600 | 348.74 | 6.8/0 | 2375/0 | - | - | 7.3/0 | 2546/0 |

REMARKS

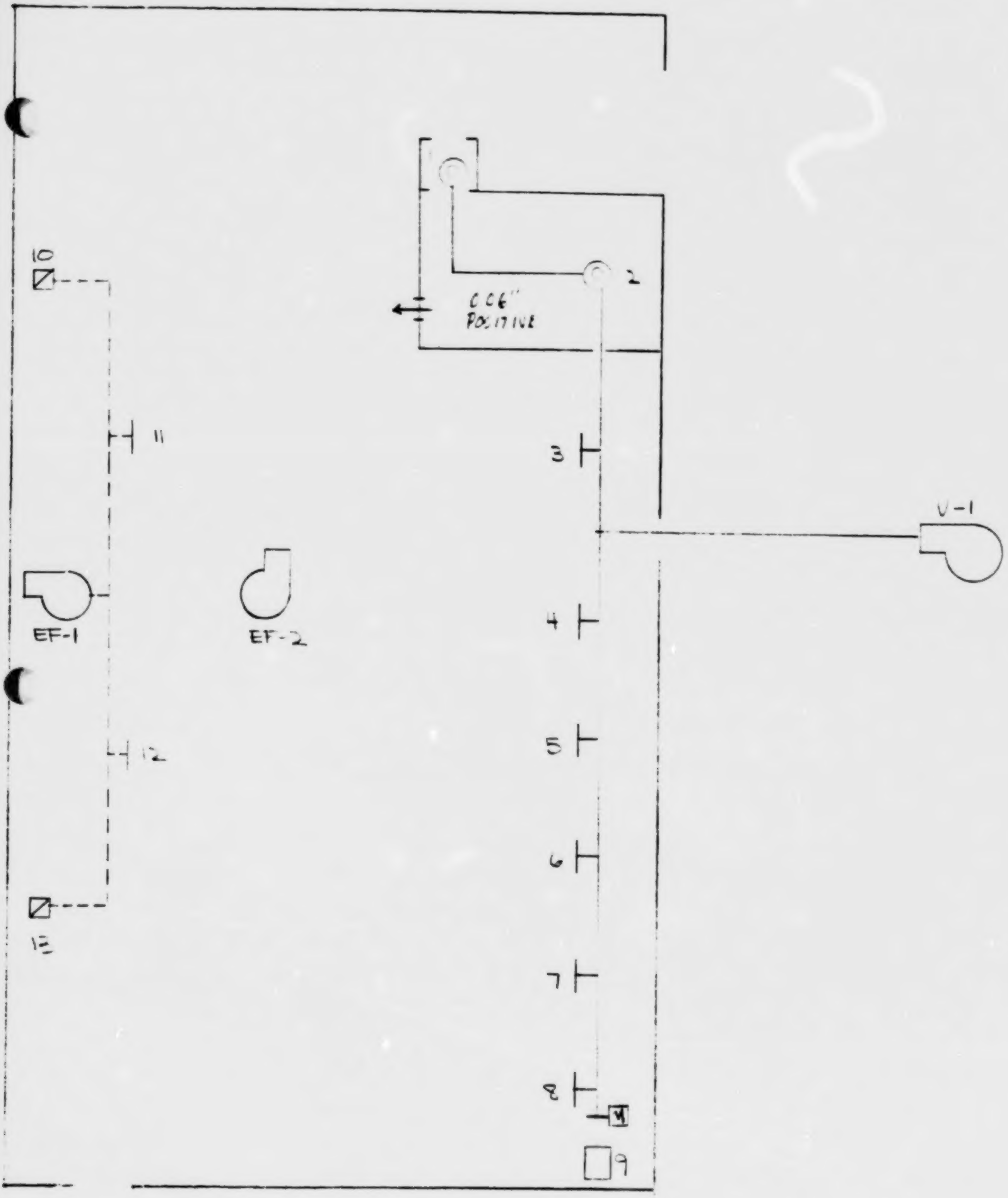
Alltec BALANCING

# AIR DISTRIBUTION TEST SHEET

SYSTEM EF-1 DATE March/88 PAGE 4 of 5

| # | LOCATION | TYPE | SIZE | AK | DESIGN m/s | DESIGN l/s | BOX | TEST | MEASURED m/s | MEASURED l/s |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | floor level | duct | 400x300 | 120.0 | 4.83 | 580 | - | - | 5.2 | 624 |
| 11 | high level | 80 | 500x250 | 100.6 | 5.86 | 590 | - | - | 6.2 | 624 |
| 12 | " | " | " | " | " | " | - | - | 6.1 | 614 |
| 13 | floor level | duct | 400x300 | 120.0 | 4.83 | 580 | - | - | 5.2 | 624 |

REMARKS


1
2
0.06"
POSITIVE
3
V-1
4
5
6
7
8
T
9
10
11
EF-1
EF-2
12
13

| | | | |
|---|---|---|---|
| ALLTEC BALANCING | DEVON-FIELD RESEARCH BLDG. | Date | MARCH/88 |
| | MAIN FLOOR PLAN | Tested by | J.K. |
| | AIR BALANCE REPORT | Drawn by | R.K. |
| | | Sheet | 5 of 5 |

FORM NO. 5.5.2

APPROVED

# ENGINEERED AIR

## DIRECT FIRED MAKE-UP AIR HEATERS

## HE SERIES

## INSTALLATION AND SERVICE

RETAIN THESE INSTRUCTIONS

MAINTAIN IN LEGIBLE CONDITION

ENGINEERED AIR
CALGARY, ALBERTA
NEWMARKET, ONTARIO
EFFECTIVE DATE - MAY/79

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**NOTICE:**

**ENGINEERED AIR'S WARRANTY IS LIMITED TO THE CONDITIONS LISTED IN ENGINEERED AIR BULLETIN WR 4002**

**This equipment shall be installed in accordance with the Installation Code of Gas Burning Appliances and Equipment CAN.1-B.149.1 & 2 and applicable Provincial Regulations for the Class. Authorities having jurisdiction should be consulted before installations are made.**

This equipment must maintain the following clearances from combustible materials:

0" Clearance from bottom
1" Clearance top, ends and side opposite control panel
24" Clearance the control side

This equipment shall be so installed that the temperature of any adjacent combustible materials shall not exceed 90°F above an ambient temperature of 77°F, or as permitted by CAN.1 - 3.7.

This equipment shall be installed so that no source of flammable vapours, gases or dust shall be within 20 feet horizontally of any unit unless that source is separated from the unit by an enclosure of vapour resistive materials.

This equipment when suspended indoors shall be installed so that sufficient working clearance is provided below the unit or the unit must be adequately protected from damage.

This equipment shall be installed so that any fire dampers in the duct work are electrically interlocked with the Unit. (i.e. damper end switch contact between terminals 4 and 5, in series with the exhaust interlock).

This equipment shall be adjusted as to maintain the toxic limits of the tempered air as set out in CAN.1 - 3.7.

This equipment shall be installed so that in the event the make-up air shut down causes a hazard to other fuel burning equipment in the building, the unit shall be interlocked to open balancing inlet air dampers.

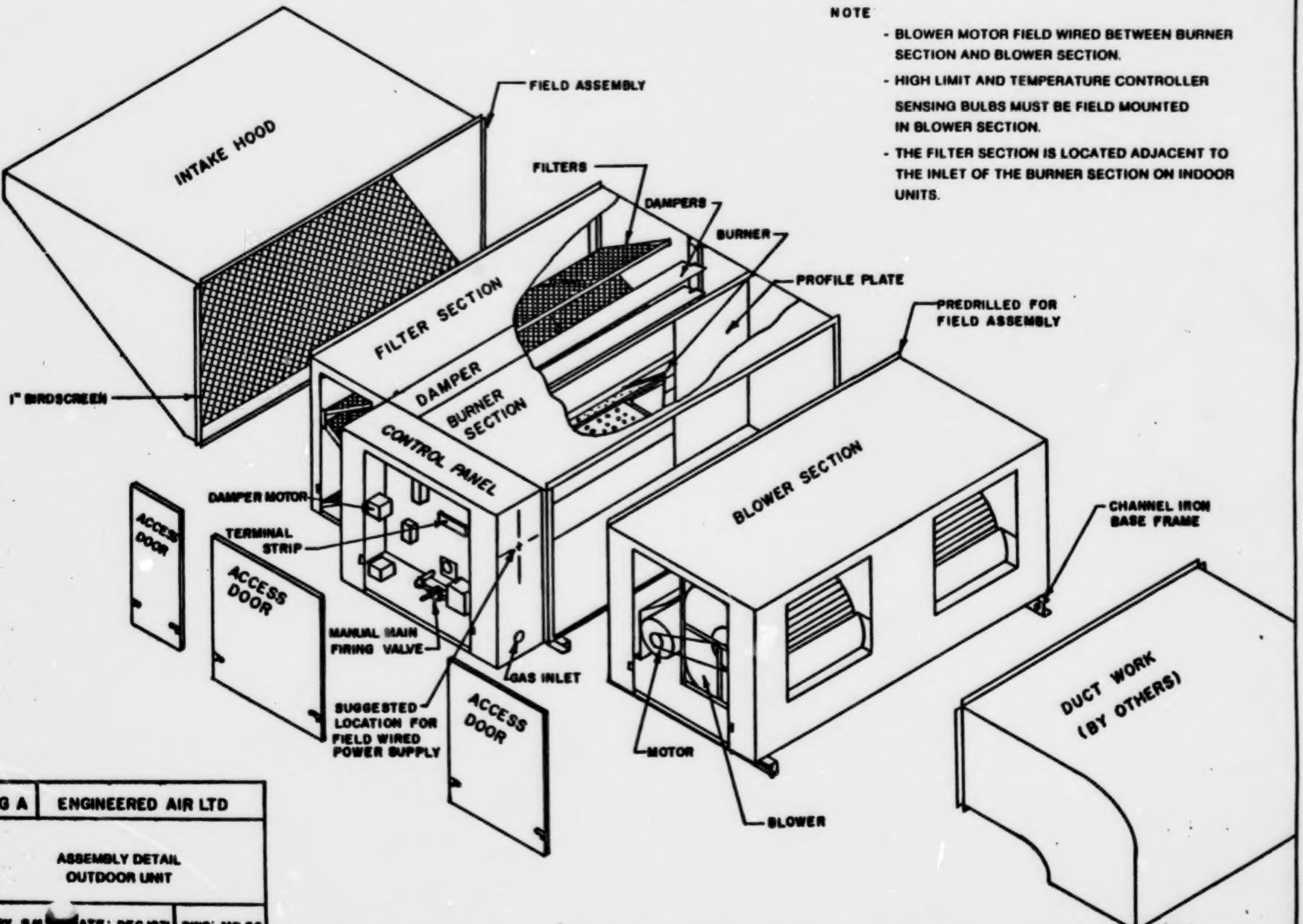
## 2. INSTALLER

### 2.1 Receiving the Unit

The following models are shipped in two pieces: HE-270, HE-340, HE-450, HE-600 (depending on area shipped to, consult factory for details). All other models shipped with the blower, burner, dampers, and filter sections pre-assembled into one piece. The inlet hoods for all machines are shipped separately.

Where a remote panel is required the panel is shipped as a separate piece.

All separate pieces are listed on the shipping order Form. Carefully check for all components and damage to any components before signing the freight bill.


INTAKE HOOD
FIELD ASSEMBLY
FILTERS
DAMPERS
BURNER
PROFILE PLATE
PREDRILLED FOR FIELD ASSEMBLY
1" BIRDSCREEN
FILTER SECTION
DAMPER
BURNER SECTION
CONTROL PANEL
BLOWER SECTION
CHANNEL IRON BASE FRAME
DAMPER MOTOR
ACCESS DOOR
TERMINAL STRIP
ACCESS DOOR
MANUAL MAIN FIRING VALVE
GAS INLET
SUGGESTED LOCATION FOR FIELD WIRED POWER SUPPLY
ACCESS DOOR
MOTOR
BLOWER
DUCT WORK (BY OTHERS)

NOTE

- BLOWER MOTOR FIELD WIRED BETWEEN BURNER SECTION AND BLOWER SECTION.
- HIGH LIMIT AND TEMPERATURE CONTROLLER SENSING BULBS MUST BE FIELD MOUNTED IN BLOWER SECTION.
- THE FILTER SECTION IS LOCATED ADJACENT TO THE INLET OF THE BURNER SECTION ON INDOOR UNITS.

| | |
|---|---|
| ENG A | ENGINEERED AIR LTD |
| ASSEMBLY DETAIL<br>OUTDOOR UNIT | |
| DRN.BY. S.H.-[illegible]ATE: DEC 1971 | DWG: MD-56 |

### 2.2 Lifting the Unit

The make-up air unit is designed with handling in mind. It or each of its sections are constructed on a heavy channel iron base frame. The frame is extended three inches beyond the entire length of the unit or section, and is pre-drilled for lifting lugs. Use spreader bars to keep the cable away from the unit cabinetry.

If the unit is lifted from the bottom (as with a fork lift) take care to lift on the channel iron base frame and not the cabinetry.

### 2.3 Assembly of Sections (See Assembly Detail)

All sections are pre-drilled for assembly. The bolts, nuts and washers are shipped in one of the sections. Simply align the sections, loosely assemble all the bolts and nuts and then tighten them up.

Rooftop units are supplied with attached gasketing material. Carefully inspect the gasket for damage or dislodgement.

The inlet hood is designed for field installation. Hook the hood on the support flange and attach with selftapping sheet metal screws.

### 2.4 Location of Unit

Refer to Clearances listed on page 1 of this form.

The purpose of a make-up unit is to replace air which has been exhausted from a building. Air may be lost from the building by exhaust fans, chimneys, or combustion air fans.

The make-up air unit should be located as far as possible away from the exhaust area in order to provide a maximum sweep of fresh air through the building. The unit's discharge should be located as high as possible in the space and directed into the least occupied areas. Avoid playing the unit discharge directly upon occupants.

### 2.5 Fresh Air Supply

The supply air to the make-up air unit must be 100% outside air. The fresh air inlet hood should be located to prevent the induction of flammable gases, toxic gases and other deterious materials. The fresh air inlet hood should be designed to prevent the induction of snow, rain, and other foreign materials.

In order to prevent condensation, any ducting between the inlet hood and the make-up air unit, should be insulated.

On indoor units the F/A inlet duct shall run straight from the unit a distance at least 1½ times greater than the unit height or 2 times greater than the unit width.

### 2.6 Exhaust Fan

The exhaust fan must be adequately sized to handle the volume of the make-up air unit. The exhaust fan should have a capacity of within 10% of the total make-up air volume. If the unit discharges directly into an exhaust booth, the exhaust fan must have a capacity at least equal to the make-up air unit.

### 2.7 External Damper Sections

At times it is desirable to have a damper section or sections external to the unit. In some cases the operation of these dampers may cause a "gas trap" - fixing a volume of air within the unit between damper sections. In a case as this a pre-purge cycle option should be used to provide at least four air changes in the ducting before an ignition attempt.

Where dampers of any kind are used, the make-up air unit shall be electrically interlocked with the dampers in such a way as to prevent ignition attempt unless the dampers are fully open.

## 3. GAS FITTER

### 3.1 Gas Manifold Connections

Where under CAN B-149 any control device which requires a bleed or vent line that device must be bled to atmosphere. Regulators may use a common vent manifold, where a vent valve will require a separate vent line.

If the make-up air unit is equipped with vibration isolation, the gas supply line should be fitted with a flexible gas line connection.

### 3.2 Fuel

Carefully check the unit name plate for fuel type and supply pressure. Size the gas line for rated input while maintaining listed inlet pressures.

## 4. ELECTRICIAN

### 4.1 General

All wiring must be in accordance with the Canadian Electrical Code.

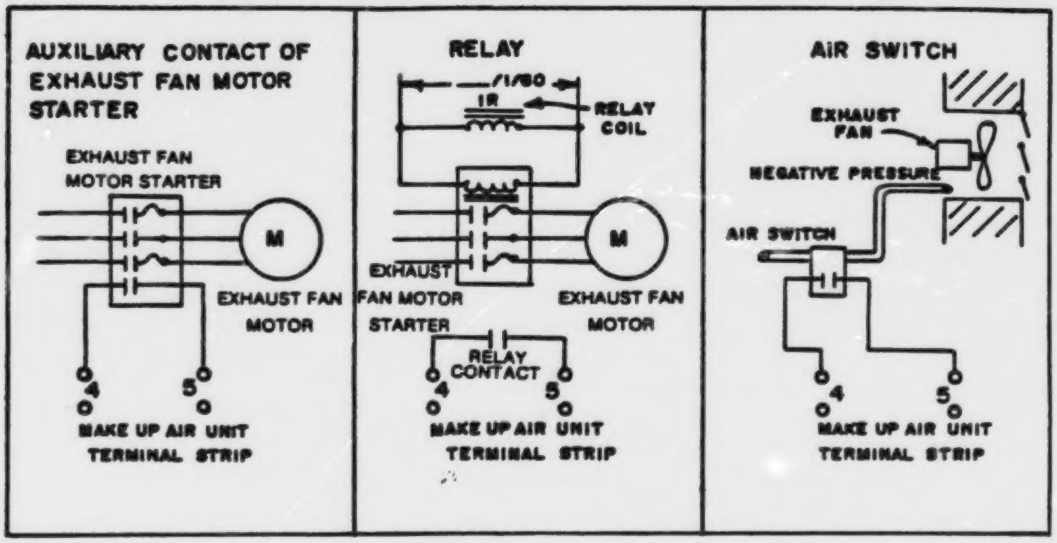
Both field wiring and internal wiring diagrams are included in the control cabinet of the unit. The power requirements are indicated on the unit name plate also found in the unit control panel.

When connecting the power supply to a three phase motor take care that the three phase wiring gives you the correct motor and blower rotation.

### 4.2 Exhaust Fan Interlocking

All direct fired make-up air units shall be interlocked with the exhaust fan so that the burner may not attempt ignition without a comparable exhaust system operating. As indicated on the field wiring diagram this contact (or contacts) is normally located between terminals four and five of the unit control terminal strip.

Three ways of accomplishing an exhaust interlock are shown below.


AUXILIARY CONTACT OF EXHAUST FAN MOTOR STARTER
EXHAUST FAN MOTOR STARTER
M
EXHAUST FAN MOTOR
4
5
MAKE UP AIR UNIT TERMINAL STRIP
RELAY
___/1/60
1R
RELAY COIL
M
EXHAUST FAN MOTOR STARTER
EXHAUST FAN MOTOR
RELAY CONTACT
4
5
MAKE UP AIR UNIT TERMINAL STRIP
AIR SWITCH
EXHAUST FAN
NEGATIVE PRESSURE
AIR SWITCH
4
5
MAKE UP AIR UNIT TERMINAL STRIP

### 4.3 Damper Interlocking

Where dampers are installed in the make-up air units ducting, an end switch shall be installed on the dampers to prove they are 100% open before the unit can attempt ignition. The end switch contacts should be wired in series with the exhaust interlock between terminals four and five of the unit control terminal strip.

## 5. START UP SERVICE MAN

### 5.1 Start Up

5.1.1 Check The following:

- The gas lines have been purged of air and are leak free.
- The circuit breakers for the control system and the blower motor are made.
- Check the automatic shut off valve for leaks, by watching for a build up in pressure between the closed manual firing valve and the safety shut off valve.

5.1.2 Push the flame safeguard reset on the flame relay in the unit control panel.

5.1.3 Set the remote manual switches to the "on" position. Switch on the exhaust system to make the exhaust interlock. The damper should begin opening immediately the manual switches and the exhaust interlocks are made. When fully open, the damper blade will make an end switch that will pull in the blower motor line starter and start the blower. If the blower fails to start, check and adjust the damper end switch. If the control system includes a low limit, for convenience the low limit should be jumpered out during start-up and adjustment. *Do not neglect to remove the jumper when start-up* is completed.

5.1.4 Open the pilot manual firing valve and switch on the heat switch on the remote panel. The pilot should then ignite or at least attempt ignition. If an attempt at ignition is made and lockout occurs, check the high limit setting to make sure that it is set at 160 degrees. If the air pressure switches are not made, lockout will also occur. Refer to trouble shooting guide. The difficulty may be an improper flame detection signal from the pilot flame rod. Where the flame relay is a Honeywell RA890, use a microameter to check the flame rod signal. A telephone style jack is provided in the flame relay for this test. The signal should be at least 2.5 microamps. If the signal is less than 2.5 ma attempt relocating the flame rod by loosening the allen head set screw and locating the rod in a better flame area. Where the flame relay is a Fireye TFM–ID use a volt meter to check the flame rod signal. A telephone style jack is provided in the flame relay for this test. If the flame signal is less than 3 volts DC follow the previous instructions on relocation of the flame rod.

5.1.5 After achieving a pilot that burns constantly while the blower is running, check the main gas valves for operation while the main manual firing valve is CLOSED. Switch off the burner. The pilot will then go out. Place a pressure gauge between the automatic valve and the manual firing valve. Switch on the burner. If the pilot comes on and proves properly, the main automatic valve should then open and the gauge should register pressure. If they do not open, check for a wiring error or a defective component.

5.1.6 Test for main flame ignition. Place a pressure gauge between the main firing valve and the burner. With the main automatic valve open, manually open the main firing valve at the rate of about 10 seconds from closed to open. Ignition should take place approximately one quarter of the turn from closed to open at which point the pressure gauge will indicate the flow of gas.

5.1.7 Do not adjust the main pressure regulator. The firing rate has been factory set and should not require any adjustment. The air temperature rise, should be as listed on the nameplate. If not, the air volume through the unit should be adjusted. This may be accomplished by adjusting the blower speed, by balancing dampers, or both. The air temperature rise should be measured, when the modulating valve is wide open.

The modulating valve can be made to stand wide open by turning the modulating temperature control up to its maximum setting and removing its sensing element from the air stream to expose it to room temperature. With proper airflow the flame should be approximately 18" long and tipped with yellow flame. If the flame is much longer and mostly yellow, or if the flame is much shorter and florescent blue only, check the trouble shooting guide for the necessary adjustments.

5.1.8 Perform a flame supervision check as follows: with the burner in full operation and firing, close the main manual firing valve and the pilot firing valve. The flame safeguard relay should then lock out and the automatic valves close. To return to normal operation, reset the flame safeguard and general reset buttons and open the manual valves.

5.1.9 Check the low limit (optional) by adjusting the setting until the unit shuts down.

5.1.10 Give the low limit and temperature controller their proper settings (See control settings).

5.1.11 The blower motor and particularly, the belt, should be checked after the previous tests and adjustments have been completed. The belt has a tendency to get loose during the maximum firing adjustment. The amperage draw of the motor should be checked with an ammeter and should not exceed the rated amperage stated on the motor rating plate; otherwise, the heater relays on the motor line will lock out the motor.

5.1.12 See that the owners have copies of the "Wiring diagrams" and the "Installation and Service Manual", and suggest that these be stored near the unit or remote panel to facilitate operating and servicing. Instruct the owners regarding starting and stopping, looking after the filters, and seasonal adjustment of main temperature scale on the Temperature controller.

## 5.2 Control Settings

The controls have been factory set at good average setting at least for start up, but they will require further adjustment in the field. The controls and their settings are as follows:

5.2.1 **Temperature Controller** – Maximum allowable temperature setting 75°F.

5.2.2 **High Limit** – Factory Set @ 150°F (not field adjustable)

5.2.3 **Electric Ignition** – Spark plug gap on the burner should be between 1/16" and 3/32".

5.2.4 **Low Temperature Limit (optional)** – Set at 40°F.

5.2.5 **High Gas Pressure Switch (optional)** – Set at 8 ounces.

5.2.6 **Low Gas Pressure Swith (optional)** – Set at 1 ounce.

## 6. OWNER

### 6.1 Operating Instructions

6.1.1 **To Switch On Blower** – Place the blower switch in the "on" position. If a remote panel has been installed, this switch will be on that panel and a light will indicate that the switch is on.

6.1.2 **To Heat The Air** – Place the heat switch in the "on" position. If remote panel has been installed, this switch will be on that panel and a light will indicate that the switch is on.

**NOTE:** The make-up air unit will not operate unless the associated exhaust system is in operation and the exhaust interlock is made. Consequently, the switches for the make-up air unit can be left in the "on" position, and this unit will automatically go into operation any time the exhaust system is switched on. If the machine is equipped with a manual low limit, a push button by-pass must be manually depressed for the first three minutes of operation. This allows the machine to fire and heat the discharge above the low limit setting (40°F).

### 6.2 Care and Maintenance

6.2.1 **Filters** – It is extremely important that the filters be checked and cleaned regularly. Clogged filters will reduce air flow through the unit, and possibly cause nuisance shutdowns. The service interval for filters varies considerably from application to application, so it will be necessary to check the filters very regularly during the period immediately following installation of the unit, in order to determine the service interval for the filters. It is important that the filters be removed in winter to prevent clogging with frost. Nuisance shut downs may also result from a heavy frost build up on the intake screen. If the intake has been properly located the conditions which cause intake hood frosting should occur rarely if ever.

6.2.2 **Lubrication** – At least once each year the blower motor, the blower and the damper motor should be oiled or greased. Do not use too much lubricant. Use only a lithieme base, high temperature grease such as alvania III, or equivelent.

6.2.3 **Safety Check** – It is recommended that once each year the safety devices on the unit should be checked. The procedure is as outlined in paragraphs (5.1.8) and (5.1.9) in section 5 "Start Up".

6.2.4 **Temperature Adjustment** – The installer should instruct the owner on how to alter the discharge temperature of the unit so that the owner can make minor adjustment himself.

ENGINEERED AIR
CALGARY, ALBERTA

# TROUBLESHOOTING GUIDE FOR DIRECT FIRED MAKE-UP AIR UNITS

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CHECKING THE LIMITS . . . . . . . . . 3
SENSING THE FLAME . . . . . . . . . . 4
AIR FLOW . . . . . . . . . . . . . . . 8

## TOP TEN TROUBLE POINTS

| OUTAGE CAUSE | SECTION REFERENCE | CORRECTION |
|---|---|---|
| (1) Dirty or Frosted filters | 6 | (1) Remove and clean during summer operation Remove for winter operation. Reset flame relay |
| (2) Frosted over intake screen | 6 | (2) Clean frost from intake screen. Reset flame relay |
| (3) Fresh air dampers frozen | 1 | (3) Remove ice - free dampers |
| (4) Door off control enclosure | 4 | (4) Jumper low cabinet temperature limit, reset flame relay. Replace door. Remove jumper after four hours of operation |
| (5) Rust laden flame rod | 5 | (5) Replace flame rod |
| (6) 110V power interuption | 4 | (6) Replenish 110V power supply. Jumper low cabinet temperature limit, reset flame relay. replace door, remove jumper after four hours of operation. |
| (7) Low discharge temperature limit | 1 | (7) Hold low limit manual by-pass in for at least 3 minutes or where automatic adjust delay relay to at least 3 minutes. |
| (8) Heat switch off | 1 | (8) For winter operation turn on manual heat switch |
| (9) Motor power supply disconnected | 1<br>4 | (9) Replenish motor power supply, reset flame relay. In case of 110 volt stepdown transformer refer to point No. 6 |
| (10) Low gas supply pressure | 2 | (10) Restore supply pressure to nameplate listing. |

## 1. STARTING SEQUENCE

If the make-up air unit fails to come on when it should, the following procedure will help you pinpoint the exact step in the starting sequence where the trouble lies. The procedure involves checking electrical terminals for power, and electrical contacts for continuity. Two very useful tools will be a continuity checker and a line voltage tattle light.

The procedure is as follows;

(a) If the unit fails to come on, take the door off the control enclosure and check the terminals on the numbered terminal strip for power. You may use terminal No. N as a neutral terminal.

(b) If No. 1 is not live, then there is no power supply to the control system. Check circuit breakers (also disconnect switch, disconnect fuses and/or control circuit transformer if these items, which are usually optional, are included in the system).

(c) If the previously tested terminal is live but No. 3 is not live, the units manual disconnect switch is not on.

(d) If the previously tested terminals are live but No. 4 is not live the external blower (fan switch) is not on. If the blower trips off on motor overload refer to air flow.

(e) If previously tested terminals are live but No. 5 is not live, the exhaust interlock is not made. The exhaust system may not be on, or the interlock(s) may have malfunctioned.

(f) If the previously tested terminals are live but No. 6 is not live, the low limit switch on the unit is not made. (The low limit control, which is an option, if used, is inserted in the circuit so that if it is open power cannot get to terminal No. 6. This control must be by-passed on start-up until the unit warms up to above low limit temperature. By-pass can be accomplished by a manual pushbutton held in to short out the low limit until the unit warms up, or by a automatic time delay which will short out the low limit for a short interval on start-up until the unit gets up to temperature. Failure to hold in the pushbutton by-pass long enough, or for too short an interval on the time delay relay, will cause shutdown).

(g) If previously tested terminals are live but No. 7 is not live, the damper end switch is not made. This switch is on the damper itself and has a trigger that makes the switch when it is pressed upward by a damper blade when fully open. If the switch does not make, it may be due to failure of the dampers not opening, of the damper motor, failure of the damper linkage, failure of the end switch, or a bent switch trigger (rebend downward to fix).

(h) If previously tested terminals are live, but No. 9 is not live, the jumper wire from 7 to 9 is not in place. And optional high outdoor temperature limit may be located between terminals 7 and 9. The contact of this limit must be made to get power through to 9.

(i) If the previously tested terminals are live, but No. 10 is not live, the manual heat switch is not on.

(j) If No. 10 is live but the burner does not come on, the trouble is probably in either the gas supply, ignition or flame supervision. (If the system includes a prepurge timer, failure of the timer to complete its cycle and make a set of contacts to provide power to the flame supervision relay could be the problem).

## 2. CHECKING THE GAS SUPPLY

For this test you will require a pressure gauge calibrated in inches water column.

Close the upstream manual pilot valve. Install the pressure gauge between the pilot solenoid valve and the downstream manual pilot firing valve. Open the upstream manual pilot valve. Push the flame safeguard reset button, recycling the ignition.

During the ignition attempt the pressure gauge should register a slight pressure.

If during the 15 second ignition attempt pressure is not registered on the gauge your problem is one of the following.

(1) Your gas supply has been turned off elsewhere on the line. This can be confirmed by using your pressure gauge and checking for pressure upstream of the pilot regulator (check nameplate for correct pressure).

(2) Your pilot regulator is maladjusted or defective. This can be confirmed by first establishing pressure upstream of the regulator, then checking for pressure downstream of the regulator.

(3) Your pilot solenoid valve is not receiving a 110V signal, or is defective. If you have pressure downstream of the regulator, but (during an ignition attempt), can not register pressure downstream of the pilot valve, then this is the case.

NOTE: ALTHOUGH YOU ARE ABLE TO ESTABLISH A PRESSURE READING, YOU MAY NOT HAVE GAS IN THE LINE. IF, FOR EXAMPLE THE HOUSE LINE HAD A LEAK REPAIR, THE LINE MAY BE FULL OF AIR AND NOT GAS. PROPER PRUGING PROCEDURES SHOULD BE USED IN REMOVING THE AIR.

THE ABOVE INSTRUCTIONS ARE ASSUMING THE GAS SUPPLY IS CLEAN AND FREE OF WATER.

## 3. CHECKING THE IGNITION

Close the main firing valve before proceeding. The ignition maybe checked by removing the blower door and observing the pilot burner. Reset the flame safeguard relay. During the following 15 second ignition attempt the ignition electrodes should clearly spark. If failure to spark occurs check the ignition electrodes and porcelain insulator for damage or misadjustment. The electrode gap should be between 1/16" and 3/32". If during the ignition cycle spark still does not occur the problem may be in the ignition lead or possibly the ignition transformer. Do not forget to replace the blower door, and open the main firing valve before proceeding.

## 4. CHECKING THE LIMITS.

If the pilot flame comes on, but goes out within a few seconds, the problem may be with one of the flame rod limits.

There can be as many as seven contacts in the flame rod circuit. The contacts are

(1) Auxiliary contact of the motor starter
(2) High Temperature limit
(3) Low velocity air switch
(4) High velocity air switch
(5) Low cabinet temperature limit (Outdoor)
(6) High gas Pressure switch (Optional)
(7) Low gas Pressure switch (Optional)

The opening of any one of the above contacts will cause a flame failure. A quick way to check to see if all the limits are made is to place a jumper between "f" of the RA890 ($S_2$ of the TFM-1D) flame relay and the flame rod. Recycle the ignition sequence.

If ignition occurs, but the main flame does not pull in, and the pilot flame goes out, then your problem is sensing the flame. – SEE SENSING THE FLAME.

If ignition occurs and the main flame pulls in, your problem is one of the limits.

YOUR LIMITS SERVE SAFETY FUNCTIONS – DO NOT LEAVE THE JUMPER IN.

All of the limits in the flame rod are single contacts, wired in series. To determine which limit is causing flame failure, shut the heat switch off and use a continuity checker individually on each limit. During this test the blower must be running.

The cause of an open contact may be as follows.

### 4.1 Motor Starter Auxiliary Contact

- is your blower running
- if your motor is overloaded it will trip on the overload heaters. Check the amperage draw
- loose terminal
- incorrect wiring
- defective auxillary contact

### 4.2 High Temperature Limit

- incorrect setting (160°)
- dislodgement of temperature sensing bulb
- loose terminal
- defective high limit

4.3 Low Velocity Air Switch
- clogged filters
- frosted over intake screen
- incorrect blower rotation
- slipping belts
- low air flow (refer to Section 6 AIR FLOW)

READ SECTION 6 AIR FLOW, BEFORE ADJUSTING AIR SWITCH

- incorrect air switch setting (turn the adjustment screw out until the contacts make. Once made turn the screw out an additional half turn)
- clogged sensing tubes
- loose wiring connection
- defective air switch

4.4 High Velocity Air Switch
- high air flow (refer to Section 6 AIR FLOW)

READ SECTION 6 AIR FLOW BEFORE ADJUSTING AIR SWITCH

- incorrect setting (turn the adjustment screw in until the contact remains closed, then turn the screw in two additional turns)
- loose wiring connection
- defective air switch

4.5 Low Cabinet Temperature Limit (outdoor units only)
- cabinet temperature too low (during servicing in cold weather the open door will eventually break the limit. Placing your thumb on the disc will momentarily make the contacts. This limit may have to be jumpered in an emergency).
- cabinet thermostat set too low (50°F)
- cabinet heater defective
- loose wiring connection
- defective thermostat
- defective low cabinet temperature limit

4.6 High Gas Pressure Switch (Optional)
- incorrect setting (8 ounces)
- loose terminal
- defective gas pressure switch

4.7 Low Gas Pressure Switch (Optional)
- incorrect setting (1 ounce)
- loose terminal
- defective gas pressure switch

## 5. SENSING THE FLAME

In order to trouble shoot flame failure resulting from a flame monitoring problem you will require a microammeter in the case of a Honeywell RA890 flame relay.

A telephone syle jack is provided in the RA890 relay for this test.

During supervision of the flame the RA890 relay must receive a steady signal in excess of 2.5 microamps to operate properly.

Where the flame relay is a Fireye TFM-1D you will require a DC voltmeter of 20,000 ohms per volt.

Two test terminals are provided on the TFM-1D relay for this test.

During supervision of the flame of the TFM-1D relay must receive a steady signal in excess of 10 volts DC to operate properly.

If in the case of either flame relay, where you actually have a flame but your flame signal is sufficiently lower than the above indicated limits that your relay locks out, then the problem is sensing the flame.

The inability of the flame relay to sense the flame may be a result of one of the following:

## Flame Trouble Shooting Guide
## Honeywell RA890

Power to terminal 9
Meter on ma scale

| METER SIGNAL DURING IGNITION ATTEMPT | CAUSE | CORRECTION |
|---|---|---|
| Dead-no needle movement | (1) open flame rod circuit resulting from broken lead or limits<br>(2) dead short of flame rod to ground<br>(3) low voltage<br>(4) defective relay | (1) repair break in circuit (see checking the limits)<br>(2) correct short and check flame relay for damage.<br>(3) line voltage should read at least 100 volts<br>(4) replace relay |
| low slightly fluctuating needle | (1) incorrectly installed flame rod<br>(2) low voltage | (1) adjust flame rod so that porcelain insulator protrudes 1/8" through pilot casting<br>(2) line voltage should read at least 100 volts |
| low rapidly vibrating needle | (1) voltage leakage | (1) replace flame rod clean and dry pilot burner section<br>(2) replace flame rod lead (use only thermoplastic insulated wire) |
| quick full scale reading - then zero | (1) dead short of flame rod to ground | (1) correct short and check flame relay for damage. |
| erratic fluctuating reading | (1) induction interference<br>(2) spark interference | (1) remove flame rod wire from interference<br>i.e. (a) flame rod wire run in same conduct as motor power supply<br>(b) flame rod wire wound around manifold piping<br>(2) spark electrodes set too wide (refer checking the ignition) |

Power to terminal 9
ter on DV volt

## Flame Trouble Shooting Guide
## Fireye TFM-1D

| METER SIGNAL DURING IGNITION ATTEMPT | CAUSE | CORRECTION |
|---|---|---|
| dead-no needle movement | (1) open flame rod circuit resulting from broken lead or limits | (1) repair break in circuit (see checking the limits) |
| | (2) dead short of flame rod to ground | (2) correct short |
| | (3) low voltage | (3) line voltage should read at least 100 volts |
| | (4) defective relay | (4) replace relay |
| low needle reading | (1) voltage leakage | (1) replace flame rod clean and dry pilot burner section<br>replace flame rod lead (use only thermoplastic insulated wire) |
| | (2) induction interference | (2) remove flame rod wire from interference<br>i.e. (a) flame rod wire run in same circuit as motor power supply<br>(b) flame rod wire wound around manifold piping |
| | (3) spark interference | (3) spark electrodes set too wide (refer checking the ignition) |
| | (4) incorrectly installed flame rod | (4) adjust flame rod so that porcelain insulator protrudes 1/8 inch through pilot casting |
| | (5) low voltage | (5) line voltage should read at least 100 volts |

Where there is a good reading during pilot operation but main flame operation causes the relay to lock out, your problem lies with one of the following:
(1) High temperature limit )
(2) Low velocity air switch ) refer checking the limits
(3) Low gas pressure switch )
(4) Modulation signal droop - refer to flame trouble shoot guide

## 6. AIR FLOW

As the burner of this machine requires a specific velocity of air passing by it, any significant changes in the air flow will affect the burner.

The air flow is governed by the blower speed and the system static.

If the system static is too high the air flow will be reduced.

If the system static is too low the air flow will be increased, and may cause the motor to trip out on the overload protection.

A quick way to determine if there is an air flow problem is to operate the burner on full fire. The air switches may have to be jumpered to do this.

The temperature controller bulb or sensor may have to be removed from the blower discharge and exposed to outdoor air to accomplish full fire.

The flame should be about 18 inches long with the occasional orange tip.

## AIR FLOW

| LOW AIR FLOW | HIGH AIR FLOW |
|---|---|
| **Full fire flame - flame has a tendency to rise, is longer than 18" and has yellow tips** | **Full fire flame - flame is less than 18" long, florescent blue, and creates an odour** |
| **Effect (1) low velocity air switch will not make**<br>**(2) Abnormally high temperature rise (see nameplate)**<br>**(3) High limit may break at 160°** | **Effect (1) Abnormally low temperature rise (see nameplate)**<br>**(2) Motor may trip out on motor over loads**<br>**(3) Occupants complaining of odours**<br>**(4) High velocity air switch may break** |
| **Causes**<br>(1) High system static<br>1.1 closed off discharge grills<br>1.2 closed off system dampers<br>1.3 design modification to system static | **Causes**<br>(1) Low system static<br>1.1 incomplete system ducting (construction heat)<br>1.2 access door off system ducting<br>1.3 design modification to system static |
| **Correction**<br>(1) Where the cause of the high system static can not be corrected, a possible solution is to close the profile plate opening. Two sliding plates are supplied on top and bottom of the profile opening for this adjustment.<br>(2) Where the low air flow is beyond the adjustment of the profile plate, the only remaining solution is to increase the blower speed to compensate for the high system static. Take care during this change that you do not exceed the amperage rating of the blower motor. | **Correction**<br>(1) Where the cause of the low system static can not be corrected, a possible solution is to open the profile plate opening. Two sliding plates are supplied on the top and bottom of the profile opening for this adjustment.<br>(2) Where the high air flow is beyond the adjustment of the profile plate, the only remaining solution is to reduce blower speed to compensate for the low system static. The motor should not tip out with correct air flow. |

**EngA** **ENGINEERED AIR**

## SUBMITTAL RECORD

JOB NAME: DEVON COAL RESEARCH. JOB NO.: 13435 (E-8166)

JSTOMER: GEN AIR VENTILATION LTD.

ENG A MODEL: HE-100-0 QTY. 1 TAG: V-1

MOUNTING: INDOOR BASE MOUNT ____ INDOOR HUNG ____ OUTDOOR ✓

ACCESS: RIGHT HAND SIDE PREFABRICATED ROOF CURB: ____

APPROX. SHIPPING WEIGHT: 435 LB. NO. OF PIECES: 2

✓* 4720/2360 L/s (10,000/5000 CFM.)

### ✓SUPPLY AIR DATA

AIR FLOW * E.S.P. 125 Pa (0.5")

FAN SIZE 18/18 QTY. 1

TSP 300 Pa (1.2") RPM 680 REQ'D POWER 2.9 kW. (3.9 BHP.)

MOTOR SIZE 5.6 kW. (7½ HP.) TYPE ODP.

### ~~RETURN AIR DATA~~

AIR FLOW ____ E.S.P. ____

FAN SIZE ____ QTY. ____

____ RPM ____ REQ'D POWER ____

MOTOR SIZE ____ TYPE ____

### AIR OPENINGS AND DAMPERS

| SERVICE | OPENING | DAMPER/TYPE | MOTORIZED | MANUAL | GRAVITY | LOCATION |
|---|---|---|---|---|---|---|
| SUPPLY AIR | ✓ | | | | | HORIZONTAL. |
| RETURN AIR | | | | | | |
| OUTSIDE AIR | | ✓ OPP. BLADE | ✓ (2) POS. | | | BACK. |
| EXHAUST AIR | | | | | | |
| | | | | | | |

### FILTER DATA

QTY/SIZE/TYPE: (6) 20x20x1" H.V. PERMANENT

QTY/SIZE/TYPE: (508x508x25)

TOTAL GROSS AREA ____ FACE VELOCITY ____

### GAS HEAT SECTION DATA

TYPE: DIRECT FIRED ✓ INDIRECT FIRED ____ ATMOSPHERIC BURNER ____ POWER BURNER ____

GAS SUPPLY: TYPE NATURAL INLET PRESSURE 7" (1750 Pa) FIELD CONNECTION SIZE 25 mm. (1")

HEAT INPUT ** HEAT OUTPUT - TEMP. RISE 61°C (110°F) FLUE DIAMETER ____

FURNACE/BURNER MODEL MIDCO/LINE HEAT EXCHANGER MATERIAL ____

### ELECTRICAL DATA

UNIT POWER SUPPLY: 575 VOLTS 3 PHASE 60 HZ BURNER MOTOR F.L.A. ____

S/A MOTOR F.L.A. 8.8 R/A MOTOR F.L.A. ____ CONTROL CIRCUIT AMPS ____

MAIN FEEDER AMPACITY 11.6 MAX. FUSE (D.E.) 15 MAX. BREAKER 20

### ADDITIONAL FEATURES

** 354 kW. (1,210,000 BTUH.)

— HORIZONTAL INLET HOOD C/W 25 mm. (1") FILTERS

- SWITCHES & LIGHTS MTD. ON UNIT CONTROL PANEL.

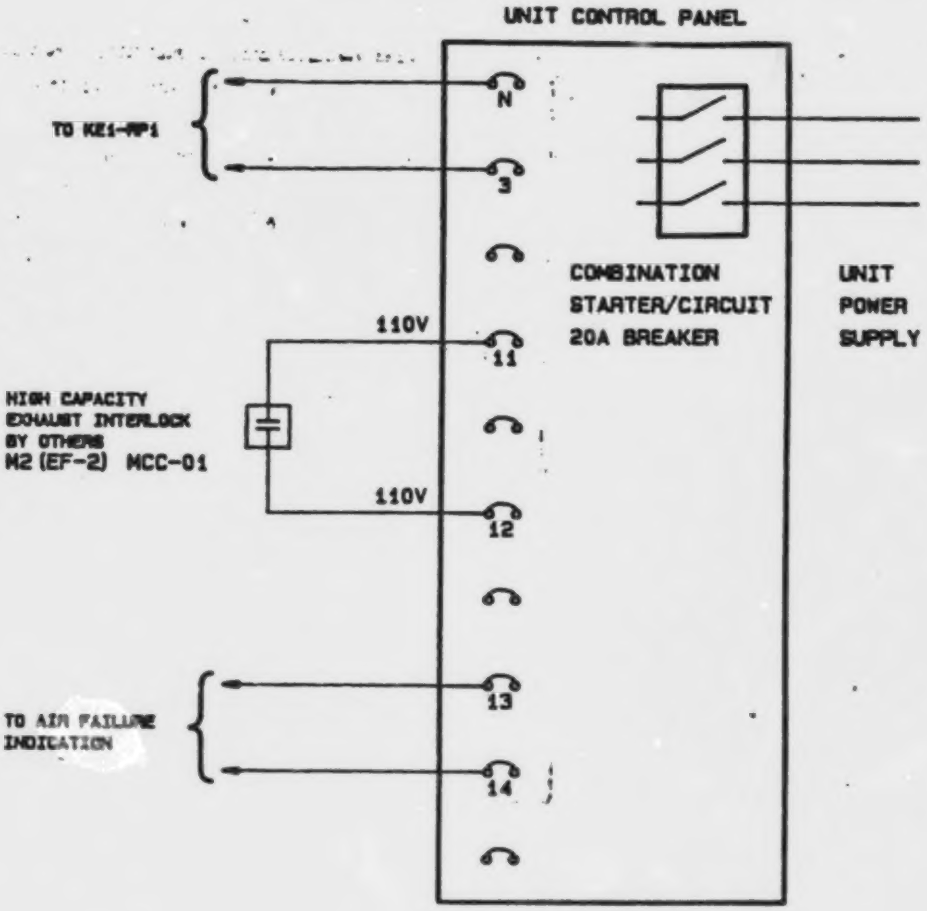
— DUAL AIR CAPACITY.

— LOW LIMIT AUTO BY PASS.

NOTE: EEMAC 4 COMBINATION STARTER/CIRCUIT BREAKER.

REVISION JAN 15 1988

DATE NOV. 27/87 SUBMITTED BY


UNIT CONTROL PANEL
TO KE1-MP1
N
3
COMBINATION STARTER/CIRCUIT 20A BREAKER
UNIT POWER SUPPLY
110V
11
HIGH CAPACITY EXHAUST INTERLOCK BY OTHERS M2 (EF-2) MCC-01
110V
12
TO AIR FAILURE INDICATION
13
14

REVISION JAN 15 1988

FUNCTION :

FAN SWITCH "ON", LOW LIMIT "MADE", DAMPER OPEN AT 30% OUTSIDE AIR
CONTINUOUS BLOWER OPERATION. HEAT SWITCH "ON" DISCHARGE AIR CONTROL. HIGH CAPACITY EXHAUST FAN "ON"
DAMPER OPEN AT 100% OUTSIDE AIR.

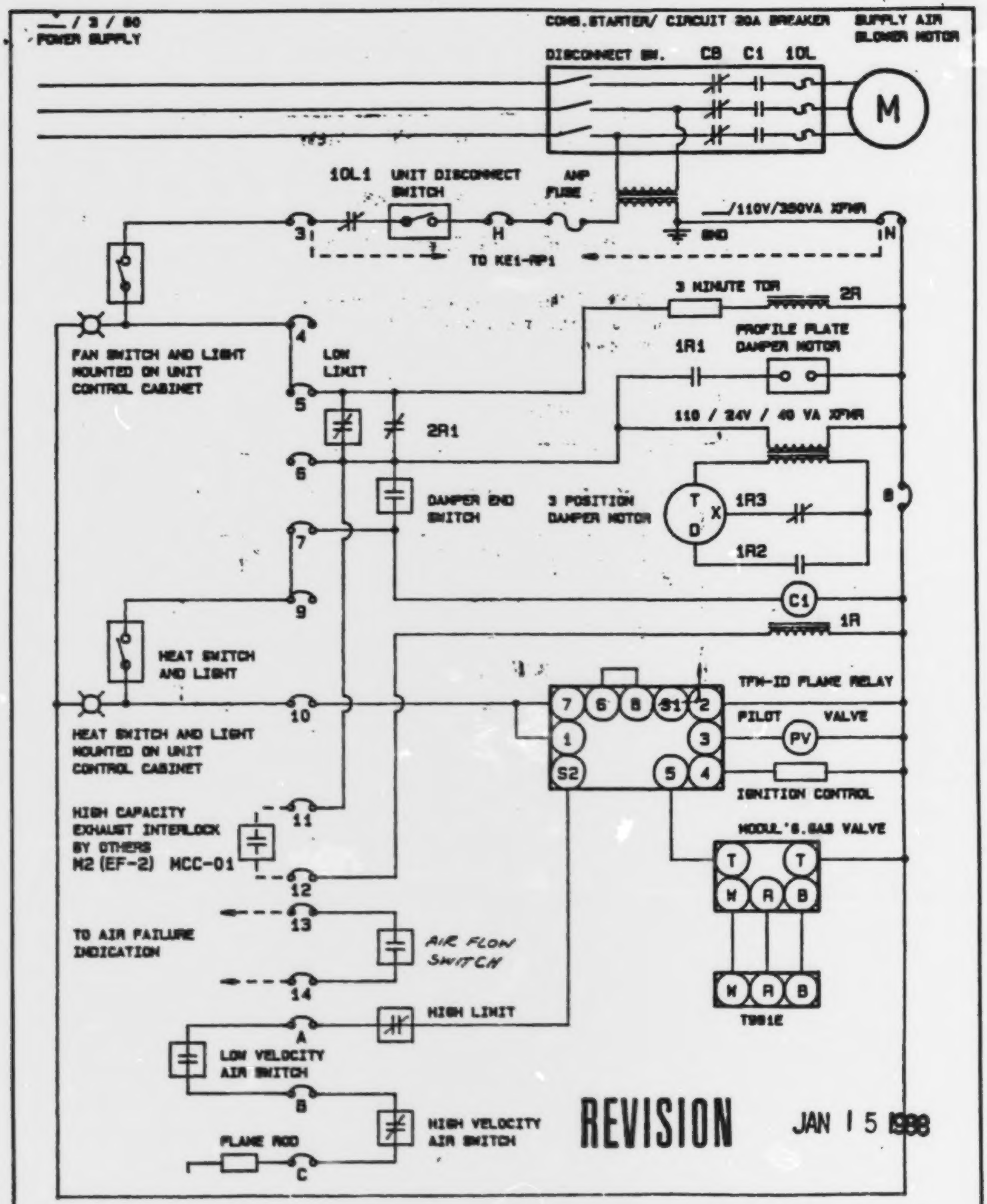
1. FIELD WIRING VOLTAGE DROP NOT TO EXCEED 10%.
2. ALL WIRING SHOWN SHALL BE COMPLETED BY INSTALLER.
3. ALL WIRING TO COMPLY WITH THE CANADIAN ELECTRICAL CODE.

EngA

ENGINEERED AIR

FIELD WIRING DIAGRAM
HE SERIES

| REVISIONS | JAN 14/88 | | |
|---|---|---|---|
| DATE: | DRN. BY | CHKD. BY: | DRWG No. |
| NOV.1987 | RJKENT | HD | FD-868-1 |


___/ 3 / 60
POWER SUPPLY
COMB.STARTER/ CIRCUIT 20A BREAKER
DISCONNECT SW.
CB
C1
1OL
SUPPLY AIR
BLOWER MOTOR
M
1OL1
UNIT DISCONNECT SWITCH
AMP FUSE
___/110V/350VA XFMR
GND
3
H
N
TO KE1-RP1
3 MINUTE TDR
2R
PROFILE PLATE DAMPER MOTOR
1R1
FAN SWITCH AND LIGHT MOUNTED ON UNIT CONTROL CABINET
4
LOW LIMIT
5
2R1
110 / 24V / 40 VA XFMR
6
DAMPER END SWITCH
3 POSITION DAMPER MOTOR
T
X
D
1R3
1R2
B
7
9
C1
1R
HEAT SWITCH AND LIGHT
10
HEAT SWITCH AND LIGHT MOUNTED ON UNIT CONTROL CABINET
TFM-ID FLAME RELAY
7
6
8
S1
2
1
3
S2
5
4
PILOT VALVE
PV
IGNITION CONTROL
MODUL'G.GAS VALVE
T
T
W
R
B
T881E
HIGH CAPACITY EXHAUST INTERLOCK BY OTHERS
M2 (EF-2) MCC-01
11
12
13
TO AIR FAILURE INDICATION
AIR FLOW SWITCH
14
HIGH LIMIT
A
LOW VELOCITY AIR SWITCH
B
HIGH VELOCITY AIR SWITCH
FLAME ROD
C

REVISION JAN 15 1988

- - - - - - - - - - DENOTES FIELD WIRING. REPLACEMENT WIRE MUST BE EQUIVALENT TO ORIGINAL WIRE SUPPLIED.

**EngA** ENGINEERED AIR

INTERNAL WIRING DIAGRAM

HE SERIES

| | | | |
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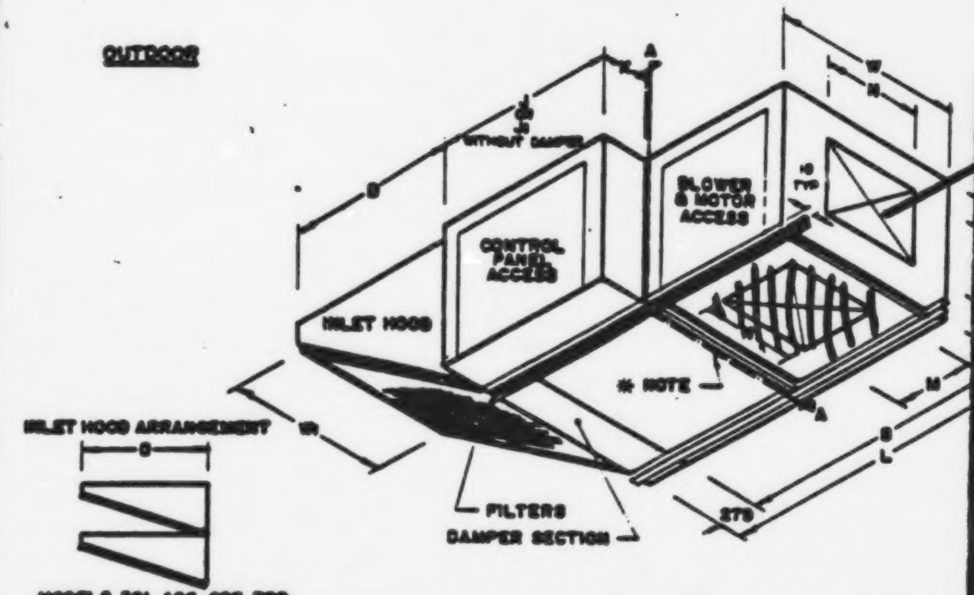


MODELS 321, 402, 600, 750

PROJ: A
JOB No. A14915
PURCH. ORDER No. SC 002
V.P. No. 5
REV. 0
EQUIP. No. V-1
Kilborn

| DIMENSIONS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HORIZONTAL DISCHARGE | | | | | | | | | | | | | | DOWN DISCHARGE | | | | | |
| MODELS | BLOWER WHEEL | L | W | W1 | H | B | D | J | J1 | K | M | N | P | L | B | P | [illegible] | [illegible] | CHANNEL HEIGHT |
| 20 | 10/10 (1) | 1702 | 559 | 635 | 686 | 1422 | 356 | 1194 | 940 | 330 | 292 | 330 | 159 | 1778 | 1499 | 51 | 737 | 508x508 (1) | 51 |
| 27 | 12/12 (1) | 1778 | 686 | 635 | 686 | 1499 | 445 | 1194 | 940 | 330 | 343 | 406 | 184 | 1880 | 1600 | 51 | 770 | 635x635 (1) | 51 |
| 40 | 12/12 (1) | 2007 | 686 | 914 | 686 | 1727 | 445 | 1194 | 940 | 330 | 343 | 406 | 184 | 2108 | 1829 | 51 | 968 | 406x635 (1)<br>508x635 (1) | 51 |
| 70 | 15/15 (1) | 2083 | 1067 | 1016 | 686 | 1803 | 851 | 1194 | 940 | 330 | 406 | 483 | 210 | 2184 | 1905 | 51 | 1364 | 508x508 (4) | 51 |
| 100 | 18/18 (1) | 2184 | 1168 | 1524 | 813 | 1905 | 762 | 1194 | 940 | 330 | 483 | 559 | 260 | [illegible] | [illegible] | [illegible] | 2112 | 508x508 (6) | 76 |
| 130 | 18/18 (2) | 2235 | 1676 | 1930 | 864 | 1956 | 914 | 1194 | 940 | 330 | 483 | 1219 | 260 | 2362 | 2083 | 76 | 3003 | [illegible] | 76 |
| 131 | 20/18 (1) | 2337 | 1168 | 1524 | 991 | 2057 | 940 | 1194 | 940 | 330 | 635 | 584 | 279 | 2489 | 2210 | 76 | 2937 | 508x635 (6) | 76 |
| 171 | 22/22(1) | 2235 | 1321 | 1651 | 1143 | 1956 | 1168 | 1194 | 940 | 381 | 692 | 692 | 311 | 2413 | 2134 | 76 | 3025 | 508x508 (6)<br>508x635 (3) | 76 |
| 180 | 18/18 (2) | 2337 | 2032 | 2032 | 864 | 2057 | 1067 | 1194 | 940 | 381 | 483 | 1524 | 260 | 2464 | 2184 | 76 | 3850 | 508x635 (8) | 76 |
| 220 | 25/25(1) | 2515 | 1473 | 1829 | 1321 | 2235 | 1486 | 1194 | 940 | 381 | 794 | 794 | 349 | 2718 | 2438 | 76 | 3960 | 508x635 (6)<br>406x635 (6) | 76 |
| 250 | 20/18 (2) | 2565 | 2159 | 2540 | 1067 | 2286 | 1245 | 1321 | 1067 | 381 | 635 | 1575 | 279 | 2718 | 2438 | 76 | 4576 | 508x635 (12) | 76 |
| 251 | 27/27(1) | 2921 | 1626 | 1905 | 1397 | 2642 | 1676 | 1321 | 1067 | 381 | 870 | 870 | 387 | 3150 | 2870 | 76 | 4785 | 508x635 (12) | 76 |
| 300 | 22/22(2) | 2667 | 2565 | 2540 | 1118 | 2388 | 1651 | 1321 | 1067 | 381 | 711 | 1880 | 311 | 2845 | 2565 | 76 | 4961 | 508x635 (15) | 76 |
| 321 | 30/30(1) | 2997 | 1753 | 2032 | 1422 | 2718 | 1270 | 1321 | 1067 | 381 | 940 | 940 | 419 | 3226 | 2946 | 76 | 5071 | 508x635 (16) | 102 |
| 400 | 25/25(2) | 2692 | 2845 | 3175 | 1321 | 2413 | 889 | 1321 | 1067 | 381 | 813 | 2134 | 349 | 2896 | 2616 | 76 | 6314 | 508x635 (20) | 102 |
| 402 | 36/30(1) | 3200 | 1930 | 1905 | 1676 | 2921 | 1486 | 1270 | 1016 | 381 | 1092 | 940 | 375 | 3429 | 3150 | 76 | 6292 | 508x635 (18) | 102 |
| 500 | 27/27(2) | 2819 | 3175 | 3048 | 1397 | 2540 | 1130 | 1448 | 1194 | 432 | 864 | 2337 | 387 | 3048 | 2769 | 76 | 7700 | 508x635 (24) | 102 |
| 600 | 30/27(2) | 3023 | 3175 | 3556 | 1524 | 2743 | 1245 | 1448 | 1194 | 432 | 940 | 2388 | 419 | 3251 | 2972 | 76 | 8580 | 508x635 (28) | 102 |
| 750 | 36/30(2) | 3175 | 3454 | 3810 | 1676 | 2896 | 1499 | 1448 | 1194 | 432 | 1092 | 2616 | 375 | 3429 | 3150 | 102 | 10670 | 508x635 (30) | 152 |

NOTES:

1. UNITS SHOWN WITH CONTROLS & ACCESS ON RIGHT HAND SIDE. LEFT HAND SIDE UNITS ARE OPTIONAL.
2. # STRUCTURAL RAILS SHOWN MAY VARY FROM UNIT TO UNIT.
3. MODELS 400, 500, 600 & 750 WITH DIMENSION "L" OVER 114", WILL BE SPLIT ALONG BREAK LINE "A-A".
4. WITHIN ALBERTA AND ONTARIO MODELS 400, 500 & 600 WILL BE SHIPPED IN ONE PIECE UNLESS OTHERWISE SPECIFIED.
5. ALL INLET HOODS ARE SHIPPED LOOSE FOR FIELD MOUNTING.

EngA ENGINEERED AIR

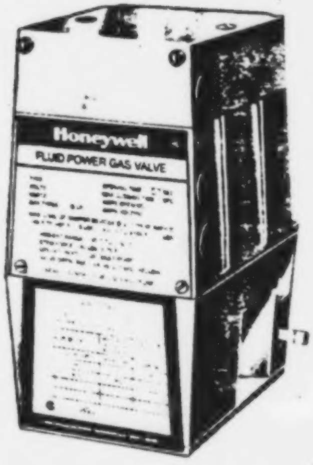
HE SERIES
DIRECT FIRED MAKE-UP AIR UNITS

DATE APRIL 88

# Honeywell

# MODULATING FLUID POWER GAS VALVE ACTUATOR

## V9055



**THE V9055 GAS VALVE ACTUATOR PROVIDES MODULATING (SERIES 90) CONTROL OF THE GAS SUPPLY TO COMMERCIAL AND INDUSTRIAL BURNERS.**

☐ Actuator opens the valve to the LO fire position when power is supplied. Actuator then modulates to meet firing rate controller demand.

☐ Actuator is equipped with an integral shaft which may be used to drive a combustion air damper in unison with the valve.

☐ The V5055 Gas Valve includes a yellow SHUT indicator. The actuator includes a red OPEN indicator. The indicators provide constant visual indication of valve position.

☐ Actuator can be used with all V5055 valve models; however, best control and low fire repeatability will result with V5055B, with characterized guide.

☐ Ambient temperature range minus 40 to 125 F [minus 40 to 53 C].

☐ Auxiliary 1/2 hp rated switch is optional and may be added in the field.

☐ Integral damper shaft provides a maximum of 20 pounds [9 kilograms] of force.

☐ Valve and actuator may be mounted in any position.

☐ Models available with NEMA 4 (weatherproof) enclosure.

☐ V9055D/V5055C,E combinations available to meet Factory Mutual valve closed indication requirements for firing more than 250 hp (12.5 million Btuh or 10,000 lbs. per hour steam) and Underwriters Laboratories Inc. 795 requirements for valve seal overtravel interlock.

☐ When replacing a V9034 actuator with a V9055, the V5034 valve body must also be replaced with a V5055.

Form Number 60-2311-5

V.J.
REV. 1-77 (048)

# SPECIFICATIONS

MODELS:

V9055A-C,E Modulating Fluid Power Gas Valve Actuators.

V9055D Modulating Fluid Power Gas Valve Actuator with valve closed indication switch.

V9055/V5055 ACTUATOR-VALVE COMBINATIONS:

| VALVE | ACTUATOR | |
|---|---|---|
| | V9055A | V9055D[a] (use with V5055C,E) |
| V5055B 3/4-3 in. | 5 psi [35 kPa] diff.; 15 psi [105 kPa] close off | – |
| V5055B 4 in. | 3 psi [21 kPa] diff.; 15 psi [105 kPa] close off | – |
| V5055A,C 3/4-3 in. | 5 psi [35 kPa] diff.; 15 psi [105 kPa] close off | 5 psi [35 kPa] diff.; 15 psi [105 kPa] close off |
| V5055A,C 4 in. | 3 psi [21 kPa] diff.; 15 psi [105 kPa] close off | 3 psi [21 kPa] diff.; 15 psi [105 kPa] close off |
| V5055D,E 3/4-1-1/2 in. | 5 psi [35 kPa] diff.; 75 psi [525 kPa] close off | 5 psi [35 kPa] diff.; 75 psi [525 kPa] close off |
| V5055D,E 2, 2-1/2, 3 in. | 5 psi [35 kPa] diff.; 45 psi [315 kPa] close off | 5 psi [35 kPa] diff.; 45 psi [315 kPa] close off |

[a]The low fire position of the V5055A,C,D and E valves will differ from those of the V5055B. Check the valve flow curves in form 70-8311 and match the low fire adjustment to the burner design and application.

ELECTRICAL RATINGS:

| VOLTAGE/ FREQUENCY | OPENING | | HOLDING | |
|---|---|---|---|---|
| | WATTS | VA | WATTS | VA |
| 120/60 | 60 | 122 | 20 | 32 |
| 100–50/60 | 57/46 | 100/81 | 25/20 | 36/31 |
| 200–50/60 | 75/53 | 164/114 | 22/19 | 36/30 |
| 220/50 | 68 | 141 | 20 | 32 |
| 240/50 | 88 | 194 | 19 | 36 |

AUXILIARY AND VALVE CLOSED (FACTORY MUTUAL) SWITCH RATINGS: 1/2 hp[a].

| | 120V | 240V |
|---|---|---|
| Full Load | 9.8 amp | 4.9 amp |
| Locked Rotor | 58.8 amp | 29.4 amp |

[a]Maximum total connected power to both switches (if used) is 1800 VA.

LOW FIRE ADJUSTMENT: 5 (nominal) to 50 (maximum) percent of actuator stem travel.

OPENING TIME: 50 Hz models–31 seconds (nominal). 60 Hz models–26 seconds (nominal).

CLOSING TIME: 1 second (maximum).

DAMPER ARM RATING (damper drives 1 direction only):

Standard Models–20 lb. maximum at 2-11/16 in. radius at plus 20 to 125 F and 5 lb. at minus 40 to 20 F [9 kg maximum at 68 mm radius at minus 7 to 66 C and 2.3 kg at minus 40 to minus 7 C].

Models with Damper Shaft Return Spring–10 lb. maximum at 2-11/16 in. radius at plus 20 to 125 F and 5 lb. at minus 40 to 20 F [4.5 kg at 68 mm radius at minus 7 to 66 C and 2.3 kg at minus 40 to minus 7 C].

# ORDERING INFORMATION

**WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER.**

**SPECIFY–**
1. **ORDER NUMBER.**
2. **VOLTAGE AND FREQUENCY.**
3. **STANDARD OPENING TIME.**
4. **ACCESSORIES, IF REQUIRED.**
5. **NEMA 4 ENCLOSURE, IF NEEDED.**

**IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:**

1. **YOUR LOCAL HONEYWELL RESIDENTIAL DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).**
2. **RESIDENTIAL DIVISION CUSTOMER SERVICE**
   **HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH**
   **MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500**

   **(IN CANADA–HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)**
   **INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.**

DAMPER SHAFT: Models available with or without integral damper shaft. Shaft is 3/8 in. [9.5 mm] for use with 7616BR damper arm. Models available with damper shaft return spring.

AMBIENT TEMPERATURE RATING: Minus 40 to 125 F [minus 40 to 52 C] for 60 Hz models, and minus 10 to 125 F [minus 23 to 52 C] for 50 Hz and 50/60 Hz models.

MOUNTING MEANS: Actuator mounts directly to valve bonnet with 2 setscrews. Valve and actuator can be mounted in any position.

INSTALLATION DIMENSIONS: See Fig. 1.

OPTIONAL SPECIFICATION: Models available with NEMA 4 enclosure.

APPROVALS:

UNDERWRITERS LABORATORIES INC. LISTED: File No. MH1639, Guide No. YIOZ.

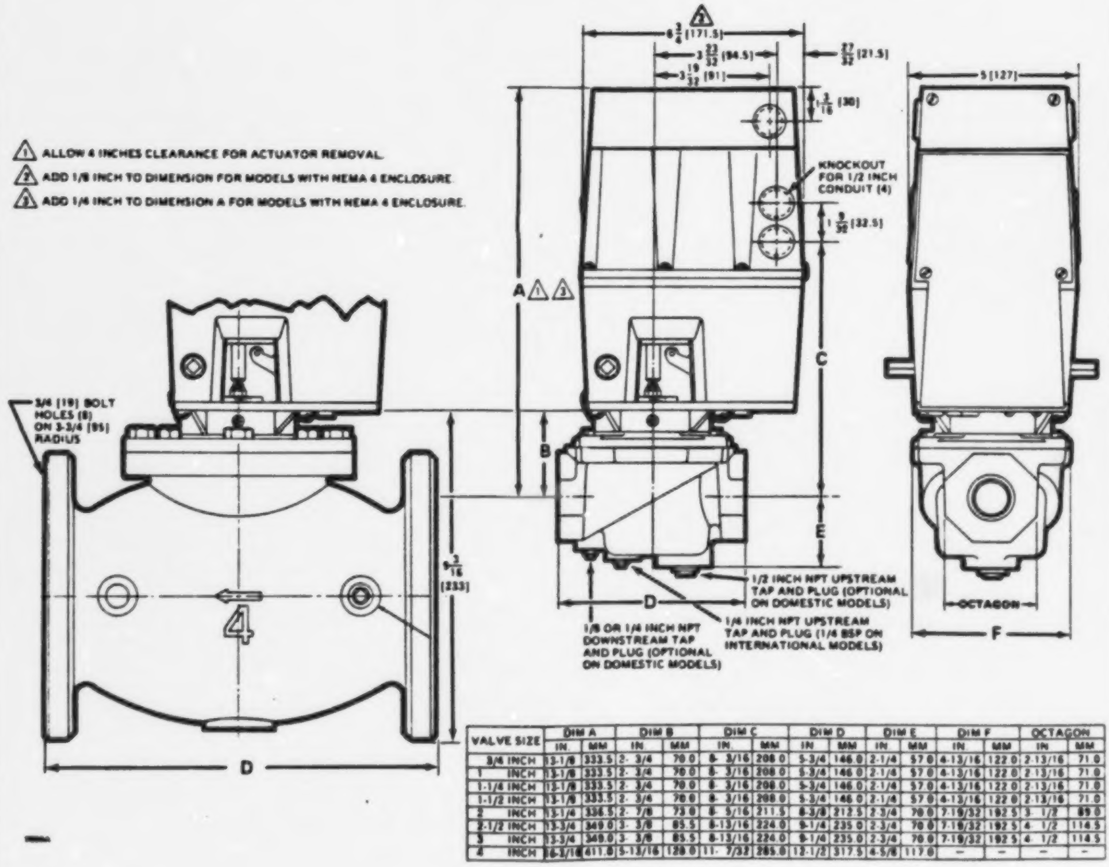
FACTORY MUTUAL APPROVED: Report Nos. 20835 and 24061.

AMERICAN GAS ASSOCIATION, INC. DESIGN CERTIFIED: Certificate No. F-273.201.

CANADIAN GAS ASSOCIATION CERTIFIED: Report No. 1029-SSV-3042,C and F (electrical features covered on Canadian Standards Association files LR1620-323 and 337).

ACCESSORIES:

1. 133568 Auxiliary Switch.
2. 7616BR Crank Arm.
3. 135769 Wrench (included with actuator).
4. 133569 Valve Closed Indication Switch Bag Assembly–must be used with V5055C or E.


1 ALLOW 4 INCHES CLEARANCE FOR ACTUATOR REMOVAL.
2 ADD 1/8 INCH TO DIMENSION FOR MODELS WITH NEMA 4 ENCLOSURE.
3 ADD 1/4 INCH TO DIMENSION A FOR MODELS WITH NEMA 4 ENCLOSURE.
3/4 [19] BOLT HOLES (8) ON 3-3/4 [95] RADIUS
4
D
9 3/16 [233]
6 3/4 [171.5]
3 23/32 [94.5]
3 19/32 [91]
27/32 [21.5]
1 3/16 [30]
KNOCKOUT FOR 1/2 INCH CONDUIT (4)
1 9/32 [32.5]
A
B
C
E
D
1/2 INCH NPT UPSTREAM TAP AND PLUG (OPTIONAL ON DOMESTIC MODELS)
1/4 INCH NPT UPSTREAM TAP AND PLUG (1/4 BSP ON INTERNATIONAL MODELS)
1/8 OR 1/4 INCH NPT DOWNSTREAM TAP AND PLUG (OPTIONAL ON DOMESTIC MODELS)
5 [127]
OCTAGON
F

| VALVE SIZE | DIM A | | DIM B | | DIM C | | DIM D | | DIM E | | DIM F | | OCTAGON | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IN. | MM | IN | MM | IN. | MM | IN | MM | IN | MM | IN | MM | IN | MM |
| 3/4 INCH | 13-1/8 | 333.5 | 2- 3/4 | 70.0 | 8- 3/16 | 208.0 | 5-3/4 | 146.0 | 2-1/4 | 57.0 | 4-13/16 | 122.0 | 2-13/16 | 71.0 |
| 1 INCH | 13-1/8 | 333.5 | 2- 3/4 | 70.0 | 8- 3/16 | 208.0 | 5-3/4 | 146.0 | 2-1/4 | 57.0 | 4-13/16 | 122.0 | 2-13/16 | 71.0 |
| 1-1/4 INCH | 13-1/8 | 333.5 | 2- 3/4 | 70.0 | 8- 3/16 | 208.0 | 5-3/4 | 146.0 | 2-1/4 | 57.0 | 4-13/16 | 122.0 | 2-13/16 | 71.0 |
| 1-1/2 INCH | 13-1/8 | 333.5 | 2- 3/4 | 70.0 | 8- 3/16 | 208.0 | 5-3/4 | 146.0 | 2-1/4 | 57.0 | 4-13/16 | 122.0 | 2-13/16 | 71.0 |
| 2 INCH | 13-1/4 | 336.5 | 2- 7/8 | 73.0 | 8- 5/16 | 211.5 | 8-3/8 | 212.5 | 2-3/4 | 70.0 | 7-19/32 | 192.5 | 3- 1/2 | 89.0 |
| 2-1/2 INCH | 13-3/4 | 349.0 | 3- 3/8 | 85.5 | 8-13/16 | 224.0 | 9-1/4 | 235.0 | 2-3/4 | 70.0 | 7-19/32 | 192.5 | 4- 1/2 | 114.5 |
| 3 INCH | 13-3/4 | 349.0 | 3- 3/8 | 85.5 | 8-13/16 | 224.0 | 9-1/4 | 235.0 | 2-3/4 | 70.0 | 7-19/32 | 192.5 | 4- 1/2 | 114.5 |
| 4 INCH | 16-3/16 | 411.5 | 5-13/16 | 128.0 | 11- 7/32 | 285.0 | 12-1/2 | 317.5 | 4-5/8 | 117.0 | – | – | – | – |

FIG. 1–V9055/V5055 DIMENSIONS IN INCHES [MILLIMETRES SHOWN IN BRACKETS].

# INSTALLATION

**CAUTION**

1. Disconnect power before connecting wiring.
2. All wiring must comply with applicable electrical codes and ordinances.
3. Power supply must be the same as that stamped on nameplate of device.
4. Only a trained, experienced, flame safeguard control serviceman should install or service this device.
5. Loads connected to the auxiliary switch, if used, must not exceed the ratings given in the SPECIFICATIONS section.
6. *Do not* attempt to use the V9055 with one of the adapters that connects the V4055 actuator to the older V5034 valves. The adapter is for use with the V4055 only. *The V9055 cannot be used with a V5034.*
7. Terminals R, W, and B are to be connected only to the proportioning controller. DO NOT APPLY ANY VOLTAGE TO THESE TERMINALS.
8. Avoid mounting actuator upside down if water is likely to drip on it. Water can be trapped in the electronics compartment in this position.

## VALVE INSTALLATION

The actuator is mounted directly on the V5055 valve bonnet after the valve is installed in the gas supply line. Refer to the instruction sheet packed with the V5055 valve for details of installation. When installing the valve, insure that:

1. Sufficient clearance is left for installation and service of the actuator.
2. Ambient temperatures at the valve location will remain within the rated ambient range.
3. Position of the valve permits hookup to the damper if one is controlled.

**IMPORTANT**

When a damper crank arm is used with a NEMA 4 actuator which is exposed to ice or sleet, a suitable shield MUST be installed to prevent ice or sleet buildup.

## INSTALL ACCESSORY SWITCHES
### (if needed)

A spdt switch may be installed to operate an auxiliary load up to 1/2 hp. The switch may be adjusted to operate at any point in the valve stroke. A valve closed indication switch may also be installed. On V5055 valves, the valve bonnet must be replaced with the valve closed indicator bonnet assembly.

The spdt valve closed indication switch is installed to make or break a circuit when the valve is in the closed position. The switch is not adjustable.

NOTE: Mark the actuator or valve to indicate any changes made.

To install the switches, proceed as follows:

1. Remove the actuator faceplate (2 screws).
2. Remove the silver-colored barrier to expose the actuator stem.
3. Insert the auxiliary switch in the position indicated in Fig. 2. Fasten with 2 screws through the actuator base.
4. Insert the valve closed indication switch in the position shown in Fig. 3. The valve closed indication switch mounts against the side of the actuator housing. The mounting holes are spaced to mount the switch only in the correct position. Fasten with 2 screws through the actuator base.
5. If only one switch is used, install the narrow barrier included with switch in the unused space.
6. Mount the actuator before making wiring connections and adjustments to the switch.

## MOUNT AND ADJUST DAMPER CRANK ARM

**IMPORTANT**

When a damper crank arm is used with a NEMA 4 actuator which is exposed to ice or sleet, a suitable shield MUST be installed to prevent ice or sleet buildup.

The crank arm provides a maximum travel of 2-5/16 inches. Refer to the instructions packed with the 7616BR Crank Arm for complete installation information.

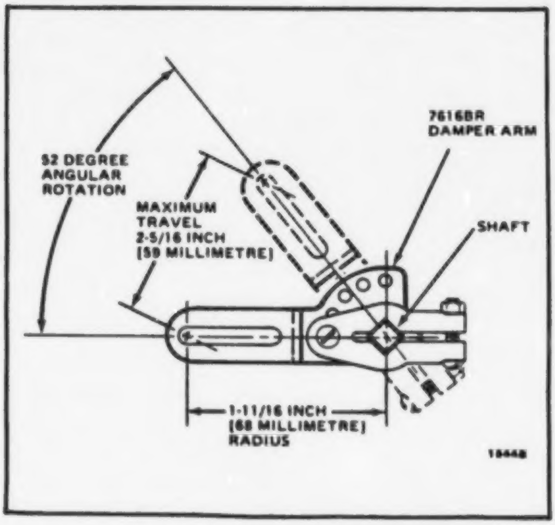


FIG. 2—CRANK ARM OPERATION.

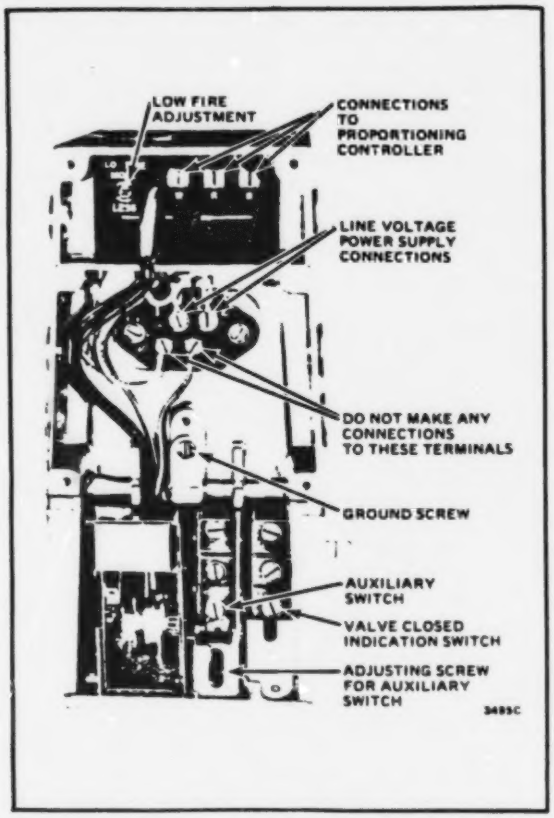

LOW FIRE ADJUSTMENT
CONNECTIONS TO PROPORTIONING CONTROLLER
LINE VOLTAGE POWER SUPPLY CONNECTIONS
DO NOT MAKE ANY CONNECTIONS TO THESE TERMINALS
GROUND SCREW
AUXILIARY SWITCH
VALVE CLOSED INDICATION SWITCH
ADJUSTING SCREW FOR AUXILIARY SWITCH

FIG. 3—INTERNAL COMPONENTS AND CONNECTIONS IN THE V9055.

## WIRING

**CAUTION**

Disconnect power supply before connecting wiring to prevent electrical shock and equipment damage.

All wiring must agree with applicable electrical codes and ordinances.

Connect power supply to terminals 1 and 2 on the terminal strip. Do not make any connections to the unmarked terminals shown in Fig. 3.

NOTE: If replacing a V9034, remove the 24 volt transformer since V9055 has a built-in transformer.

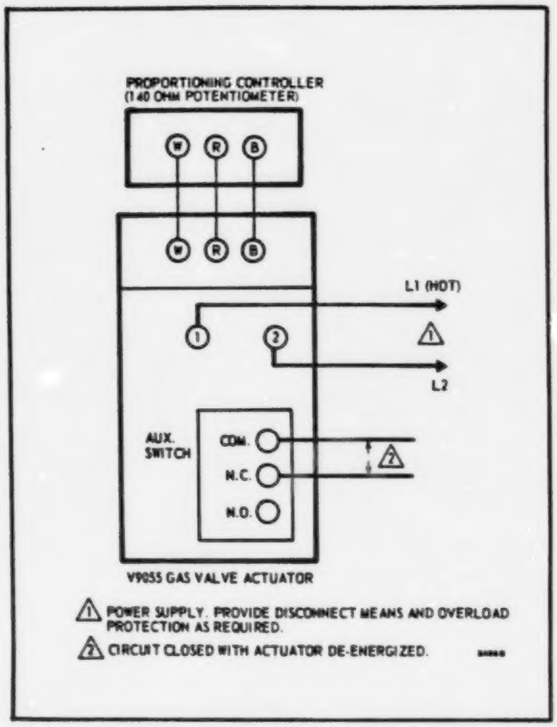

PROPORTIONING CONTROLLER (140 OHM POTENTIOMETER)
W
R
B
L1 (HOT)
1
2
L2
AUX. SWITCH
COM.
N.C.
N.O.
V9055 GAS VALVE ACTUATOR
1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2 CIRCUIT CLOSED WITH ACTUATOR DE-ENERGIZED.

FIG. 4—HOOKUP FOR THE V9055 MODULATING GAS VALVE ACTUATOR.

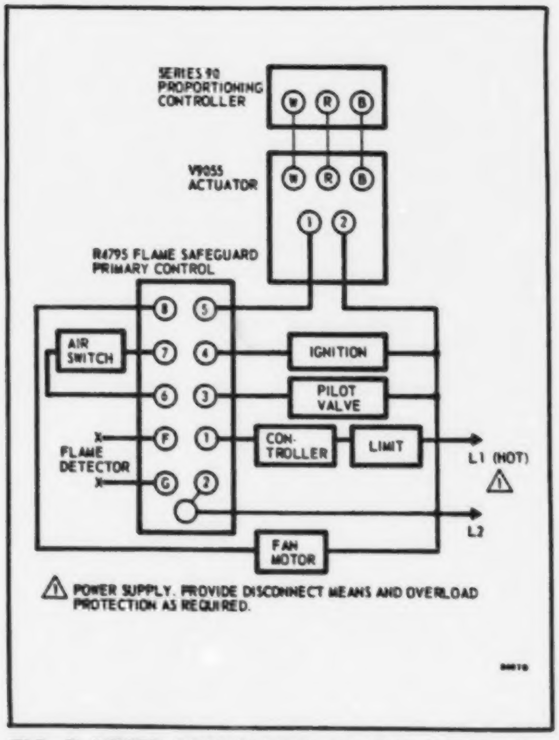

SERIES 90 PROPORTIONING CONTROLLER
W
R
B
V9055 ACTUATOR
1
2
R4795 FLAME SAFEGUARD PRIMARY CONTROL
8
5
AIR SWITCH
7
4
IGNITION
6
3
PILOT VALVE
F
1
CON-TROLLER
LIMIT
L1 (HOT)
FLAME DETECTOR
G
2
L2
FAN MOTOR
1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

FIG. 5—V9055 CONNECTED TO THE R4795 IN A TYPICAL APPLICATION.

# ADJUSTMENTS

**IMPORTANT**

**When using the V9055 with the V5055C or E (with Factory Mutual double seat) match low fire minimum adjustment to burner and application. Too low an adjustment could result in loss of burner flame. This low fire adjustment should also be checked at periodic maintenance intervals.**

## ADJUST LOW FIRE ADJUSTMENT

The low fire setting is adjustable from 5 (nominal) to 50 (maximum) percent of actuator stem travel. The low fire adjustment is factory-set at the maximum position (approximately 50 percent of full gas flow capacity). Check to be sure the low fire setting is at maximum (full clockwise) before starting the adjustment procedure. To adjust:

1. Remove the lead to V9055 terminal R. Jumper terminal R to W. This will prevent the actuator from going to the high fire position.

2. Using a Phillips screwdriver, turn the low fire adjusting screw to the desired low fire position. DO NOT PUSH INWARD ON SCREW.

Shut down the burner, and then restart. Repeat several times to be sure the low fire setting is suitable for correct burner light off.

Turn off power supply. Remove R-W jumper, and reconnect the lead to terminal R on the V9055.

## ADJUST THE AUXILIARY SWITCH
(if used)

The auxiliary switch is adjustable throughout the stroke of the actuator. With the switch installed in the actuator, turn the adjusting screw (Fig. 3) clockwise ↷ to cause the switch to operate earlier in the stroke and counterclockwise ↶ to operate later in the stroke.

# OPERATION

To function as intended, the V9055 must be connected to a properly sized valve. Too large a valve will not properly modulate the gas flow.

When the actuator is energized, it will drive at least to the adjustable low fire position. How far it will open beyond this low fire position depends on the demands of the modulating controller.

When the controller calls for no heat, the actuator will modulate the valve to the low fire position. When power to the actuator is interrupted, the valve will be closed all the way.

Fig. 5 shows the V9055 in a typical flame safeguard control system.

# CHECKOUT AND SERVICE

## CHECKOUT

**CAUTION**

**Only a trained, experienced, flame safeguard control serviceman should service or replace this control.**

After the valve installation is complete, cycle the valve a few times with the manual fuel shutoff cock closed before testing the system in actual operation.

## SERVICE

The actuator is *not* field repairable, except for replacing the auxiliary switch. See page 4 for procedure. Do *not* disassemble the valve actuator. Perform the following checks before removing and replacing the V9055 gas valve actuator.

1. With manual gas valve closed, energize the V9055 and check for voltage on terminals 1 and 2. Actuator should modulate to the low fire position.

2. Disconnect the leads from the modulating controller (terminals W, R, and B). Connect a manual potentiometer, color-to-color, to terminals W, R, and B on the actuator. With the valve energized, use the potentiometer to open and close the actuator. It should run from low fire position to full open.

If the actuator itself has failed, return it to the factory for repair.

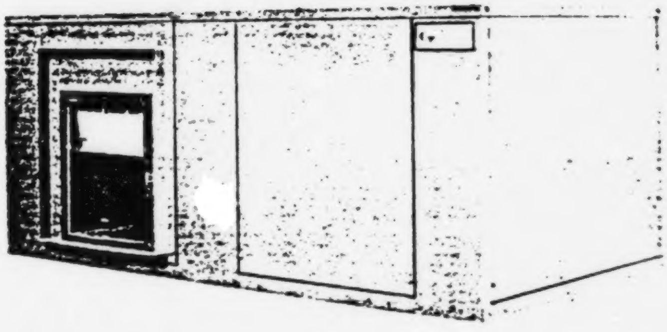
**HONEYWELL MINNEAPOLIS, MINN. 55408 INTERNATIONAL Sales Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.**

**PRINTED IN U.S.A.**

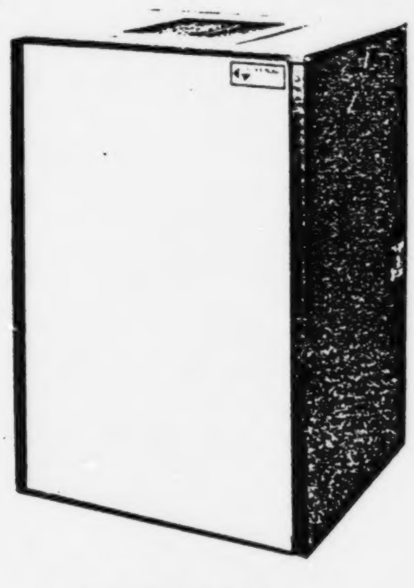
# Buffalo Package Equipment

Manufactured by Climate-Master

# WATER COOLED PACKAGE UNITS



HQT SERIES



QT SERIES

# SERVICE MANUAL

## NOTICE

This service manual is intended for the use of qualified individuals specially trained and experienced in servicing air conditioning equipment and related system components.

Persons not qualified should not attempt to install or service this equipment. Improper installation or service may damage the equipment, will void the warranty, and may create a hazard.

This manual does not cover the basic principles of cooling. The user of this manual should be familiar with the basic principles of cooling and should use this manual exclusively for servicing QT, HQT Series Standing Package Units.

Being service-oriented this manual does not cover all the details of the air conditioner installation. Installation instructions are packed with each air conditioner, and copies are available upon request.

## INTRODUCTION

QT, HQT Series Standing Package Air Conditioners are self contained water cooled units for residential and light commercial applications. The units are designed for either free blow or duct connection.

The three ton capacity units are available in single and three phase models. Each unit includes a water regulating valve and a water union to facilitate servicing the valve.

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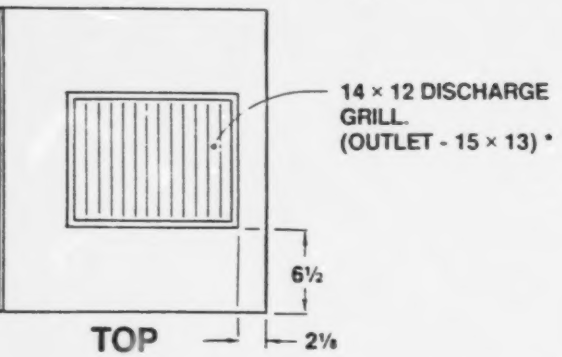
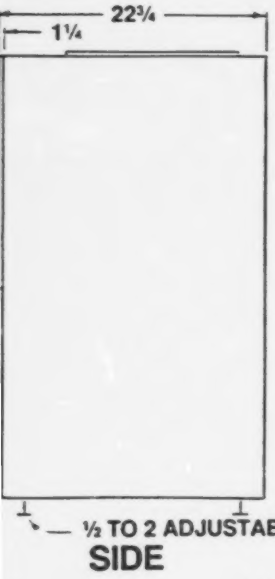
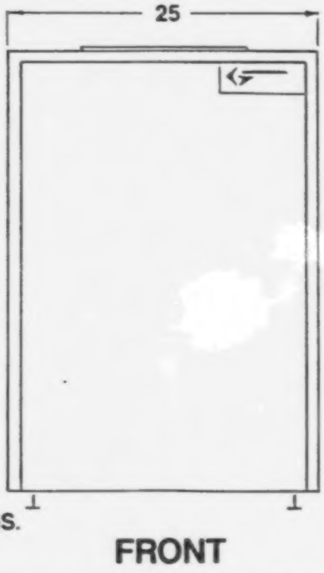
# QT SERIES DIMENSIONS

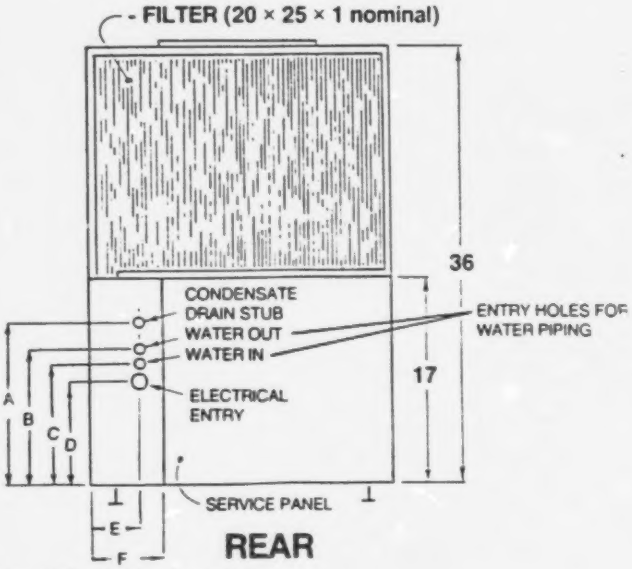
ALL DIMENSIONS ARE
IN INCHES

| DIMENSIONS | | CONNECTION SIZES | |
|---|---|---|---|
| A | 12½" | Condensate Drain | ¾" O.D. |
| B | 10" | Water Supply * | ⅜" F.P.T. |
| C | 8¾" | Water Outlet * | ⅝" O.D. |
| D | 7½" | *Inside Unit - Not shown on diagram | |
| E | 3" | | |
| F | 4⅛" | | |


14 × 12 DISCHARGE
GRILL.
(OUTLET - 15 × 13) *
6½
2⅛
TOP


22¾
1¼
½ TO 2 ADJUSTABLE LEGS.
SIDE

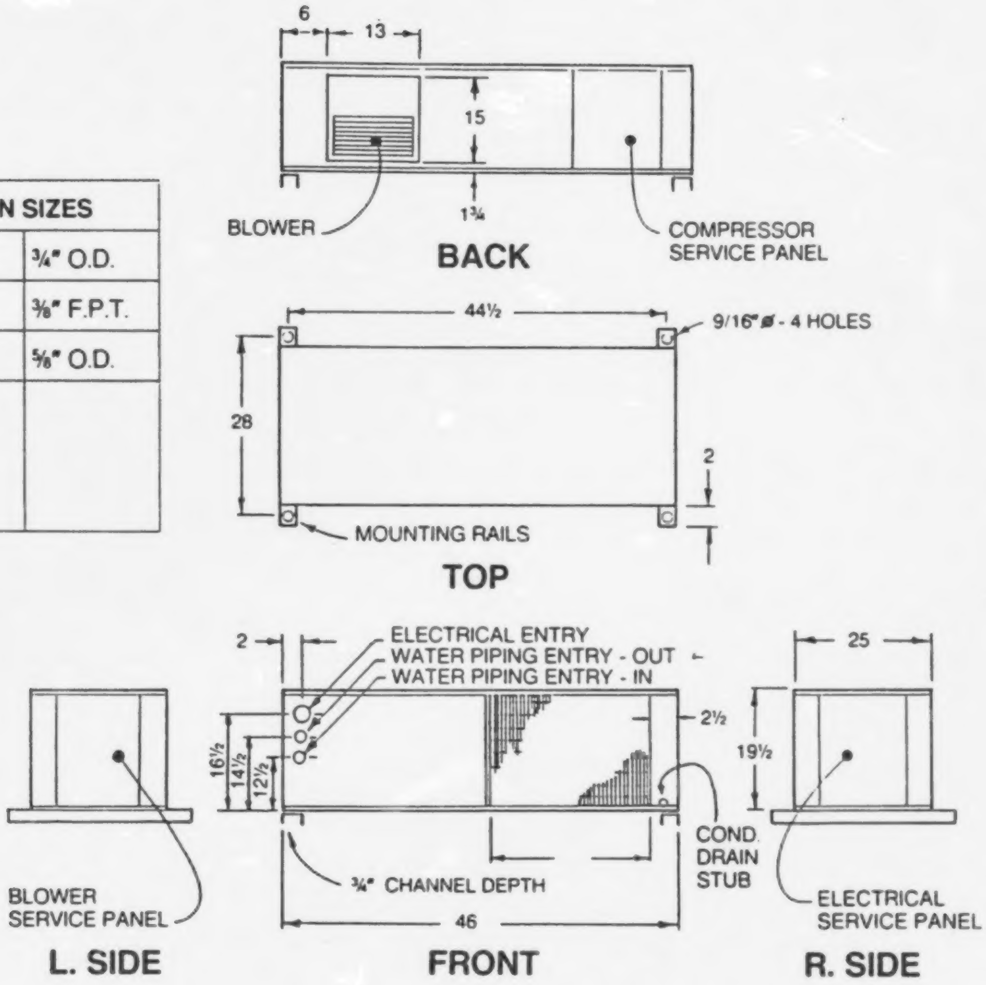



FILTER (20 × 25 × 1 nominal)
36
17
CONDENSATE
DRAIN STUB
WATER OUT
WATER IN
ELECTRICAL
ENTRY
ENTRY HOLES FOR
WATER PIPING
A
B
C
D
E
F
SERVICE PANEL
REAR

* When ducting, remove discharge grill and use 15" × 13" connection

# HQT SERIES DIMENSIONS

| CONNECTION SIZES | |
|---|---|
| Condensate Drain | ¾" O.D. |
| Water Supply * | ⅜" F.P.T. |
| Water Outlet * | ⅝" O.D. |
| *Inside Unit - Not shown on diagram | |


6
13
15
1¾
BLOWER
COMPRESSOR SERVICE PANEL
BACK
44½
9/16"ø - 4 HOLES
28
2
MOUNTING RAILS
TOP
2
ELECTRICAL ENTRY
WATER PIPING ENTRY - OUT
WATER PIPING ENTRY - IN
25
2½
19½
16½
14½
12½
COND. DRAIN STUB
¾" CHANNEL DEPTH
46
BLOWER SERVICE PANEL
ELECTRICAL SERVICE PANEL
L. SIDE
FRONT
R. SIDE

## SPECIFICATIONS

| MODEL | | | QT-20-1<br>HQT-20-1 | QT-26-1<br>HQT-26-1 | QT-33-1<br>HQT-33-1 | QT-39-1<br>HQT-39-1 | QT-39-3<br>HQT-39-3 |
|---|---|---|---|---|---|---|---|
| Nominal capacity (tons) | | | 1-1/2 | 2 | 2-1/2 | 3 | 3 |
| Capacity (BTU/hr)* | | | 19,600 | 25,750 | 32,850 | 39,125 | 39,125 |
| Refrigerant type | | | R-22 | R-22 | R-22 | R-22 | R-22 |
| Factory refrigerant charge (oz.) | | | 36 | 37 | 38 | 52 | 52 |
| Compressor | | | Tecumseh<br>AJ5518E | Tecumseh<br>AB5524F | Tecumseh<br>AH5531E | Tecumseh<br>AH5540E | Tecumseh<br>AH5540E |
| Electrical Data | Power Required | Volts | 230 | 230 | 230 | 230 | 230 |
| | | Phase | 1 | 1 | 1 | 1 | 3 |
| | | Cycle | 60 | 60 | 60 | 60 | 60 |
| | Compressor | R.L.A. | 10.5 | 12.2 | 17.5 | 22.0 | 12.5 |
| | | L.R.A. | 53 | 64 | 75 | 103 | 72 |
| | Run Capacitor | Voltage | 370 | 370 | 370 | 440 | - |
| | | M.F.D. | 25 | 35 | 35 | 35 | - |
| Evaporator Coil | Face area (Sq. Ft.) | | 2.3 | 2.0 | 2.3 | 2.3 | 2.3 |
| | Copper Tubing (O.D. in.) | | 3/8 | 3/8 | 3/8 | 3/8 | 3/8 |
| | Rows deep | | 2 | 3 | 3 | 3 | 3 |
| | Fins per inch | | 14 | 14 | 14 | 14 | 14 |
| | Capillary | | Qty. 2<br>.054 I.D.<br>x 50" | Qty. 3<br>.054 I.D.<br>x 30" | Qty. 3<br>.070 I.D.<br>x 40" | Qty. 3<br>.070 I.D.<br>x 32" | Qty. 3<br>.070 I.D.<br>x 32" |
| Blower | Motor size (hp) | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| | Motor rating (R.L.A.) | | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| | Airflow (c.f.m.) | | 600 | 800 | 1000 | 1200 | 1200 |

*ARI Std. - 67° Fwb, 80° Fdb on evaporator
75°F water on, 95°F water off condenser

# SEQUENCE OF OPERATION

The thermostat governs the running time of an air conditioner. When the room temperature goes above the desired setting, the thermostat contacts close and connect power to the control circuit. When the compressor contactor's holding coil is energized, it closes the main contacts and completes the circuit to the compressor. The compressor will operate until the desired room temperature is reached. Then the electrical circuit is opened and the compressor stopped. The evaporator blower motor operates whenever the thermostat contacts close.

## START UP INSTRUCTIONS

Follow the procedure outlined below when starting a new system.

Preliminary checks:

- electrical supply ± 10% of 230V
  (use high torque kit on single phase unit if unit fails to start)
- water supply adequate and free from sediment
- air flow rate 400 c.f.m. per ton of cooling

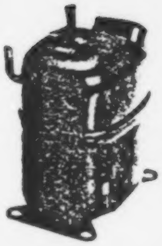
Start and check:

1. Set thermostat to cool and lower the setting so that the contacts close.
2. Adjust water regulating valve to 250 psig. head pressure.
3. Let unit run for 1/2 an hour listening for any abnormalities.

   Check - voltage and amperage at compressor.
   - high and low pressure readings (should be approximately 65 - 75 psig. suction and 250 psig. head depending on evaporator load).
   - temperature drop across the coil (should be approx. 20 - $25^{O}$F d.b.).
4. Reset the thermostat to the desired temperature.

## COMPONENTS

1. Compressor - The compressor is a hermetic type driven by a permanent split capacitor motor. It pumps heat-laden, low pressure gas from the evaporator to a higher pressure.



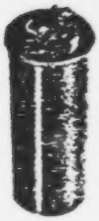
The compressor motor is protected by an overload device which opens the compressor circuit if there is excessive current draw, excessive temperature or both.

The QT-20-1, HQT-20-1 compressor motor is protected by an external line break overload. Continuity should be present between the two terminals of a cool overload. Use only Tecumseh replacement parts.

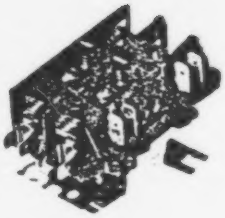
All other compressors are protected by internal line break overloads. Continuity can be checked only when the compressor is cool to touch. Internal overloads are not repairable or replaceable.

All compressors except QT-20-1, HQT-20-1 are equipped with internal relieve valves. The valves open to prevent abnormally high head pressures or to relieve hydraulic pressures in the event of slugging. They reset when the compressor stops and the pressure equalizes.

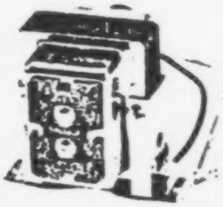
2. Run Capacitor - The run capacitor is connected between the run (R) and the start (S) terminals and is in series with the start winding. It is located at the back of the control box. Never substitute a capacitor with a lower voltage rating. For the QT, HQT Series you may substitute a capacitor with an additional 5 MFD if the specified size is not available.



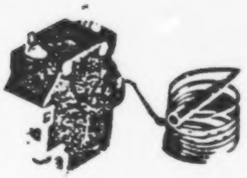
3. Compressor Contactor - The compressor contactor is a 24 volt control device that connects the line current to the compressor motor. It has heavy contacts and a holding coil. When the coil is energized the normally open contacts close and carry the current to the compressor motor. Do not replace the contactor with a lower amp rated contactor.



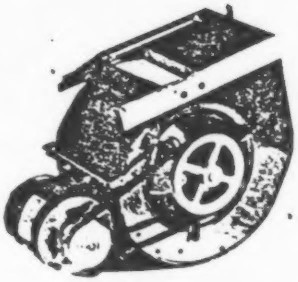
4. Transformer - The transformer is a 24 volt control circuit step-down transformer designed to power the 24 volt control system. The low voltage side of the transformer must be 24 volt for proper control circuit operation.



5. High Pressure Control - The high pressure switch is in the control circuit and provides protection against abnormally high pressures. The control is normally closed but opens when the pressure is over 400 psig. It can be reset manually by pushing the button labelled "push to reset" on the front of the control box.

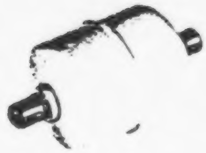


6. Blower/Motor Assembly - The blower pulls warm air over the evaporator at the back of the unit and discharges the conditioned air. The motor is single phase, single speed, 230 volt and controlled by the fan contactor. The motor is equipped with an automatic reset thermal overload protector that opens the motor circuit before the temperature becomes dangerously high. The contacts of the device remain open long enough for the motor to cool, then automatically close the motor circuit.

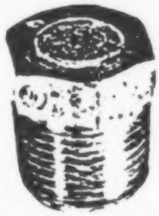


The motor's sleeve bearing needs to be re-oiled with a good grade of SAE20 motor oil when the motor is put in service and after each 5,000 hours of operation thereafter. Motor failure can be prevented by lubricating at proper intervals.

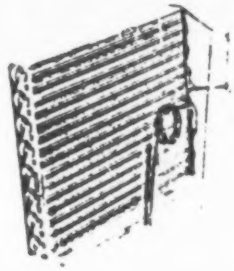
7. Filter Drier - The filter drier is a protective device that is located in the liquid line before the capillary tubes. It protects the system from water, acid and dirt. The filter drier is one directional with the arrow in the direction of the evaporator. If the temperature at the drier inlet is higher than the outlet, then the filter drier is restricted and must be replaced.



8. Fusible Plug - The fusible plug is a device that relieves pressure if the refrigerant is over 210°F.



9. Evaporator - The evaporator is made of seamless copper tubing and aluminum fins. Warm airflow over the evaporator coil boils the low pressure liquid refrigerant to a super heated vapour, which then re-enters the compressor. Heat and moisture are removed from the warm air by the evaporator and a cool conditioned air is discharged into the space by the blower. The evaporator fins should be kept straight and clean for proper unit operation.



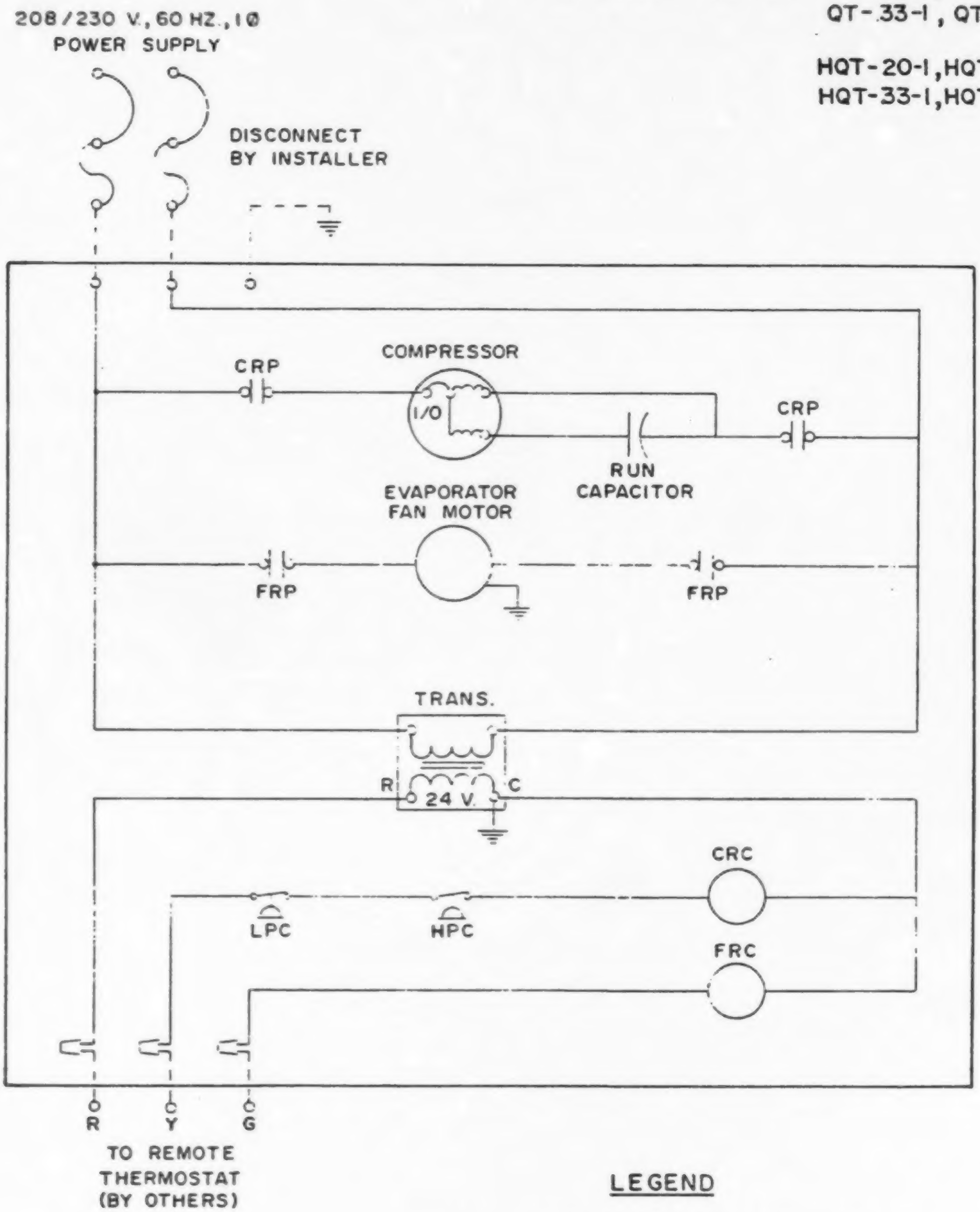
10. Condenser - The condenser is a water cooled type, tube within a tube, the outer tube carrying refrigerant, the inner tube carrying water. The condenser cools the high pressure hot gas to a liquid. Heat is removed by heat exchange between the hot gas and water running through the condenser.

11. Water Regulating Valve - The valve is located in the inlet water supply to the condenser and is used to modulate the water flow requirements as required by load. The valve opens and increases water flow to the condenser when the high side pressure increases. The valve closes when the unit is not running. Valve removal is facilitated by the use of a water union.

Buffalo Package Equipment

INTERNAL WIRING QT-20-1, QT-26-1,
QT-33-1, QT-39-1.

HQT-20-1, HQT-26-1,
HQT-33-1, HQT-39-1


208/230 V., 60 HZ., 10
POWER SUPPLY
DISCONNECT
BY INSTALLER
CRP
COMPRESSOR
I/O
CRP
RUN
CAPACITOR
EVAPORATOR
FAN MOTOR
FRP
FRP
TRANS.
R
24 V.
C
CRC
LPC
HPC
FRC
R
Y
G
TO REMOTE
THERMOSTAT
(BY OTHERS)

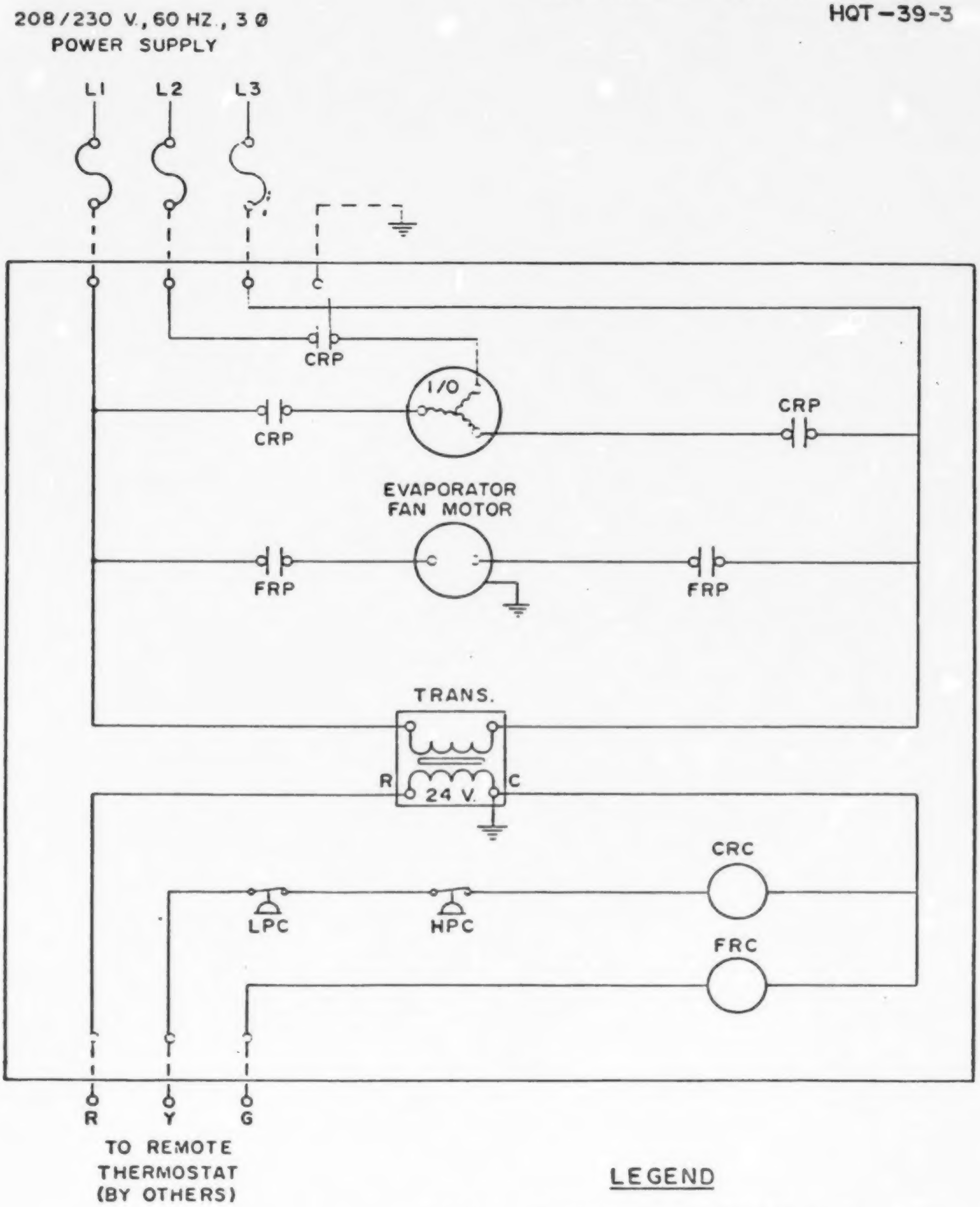
LEGEND

I/O - INTERNALLY PROTECTED MOTOR
CRP - COMPRESSOR RELAY CONTACTS
FRP - FAN RELAY CONTACTS
CRC - COMPRESSOR RELAY COIL
FRC - FAN RELAY COIL
HPC - HIGH PRESSURE CONTROL
LPC - LOW PRESSURE CONTROL (OPTION)

NOTE: FAN MOTOR IS THERMALLY PROTECTED.

DATE: SEPT. 13, 83 N.D.

INTERNAL WIRING QT-39-3
HQT-39-3


208/230 V., 60 HZ., 3 Ø
POWER SUPPLY
L1
L2
L3
CRP
I/O
CRP
CRP
EVAPORATOR
FAN MOTOR
FRP
FRP
TRANS.
R
24 V.
C
CRC
LPC
HPC
FRC
R
Y
G
TO REMOTE
THERMOSTAT
(BY OTHERS)

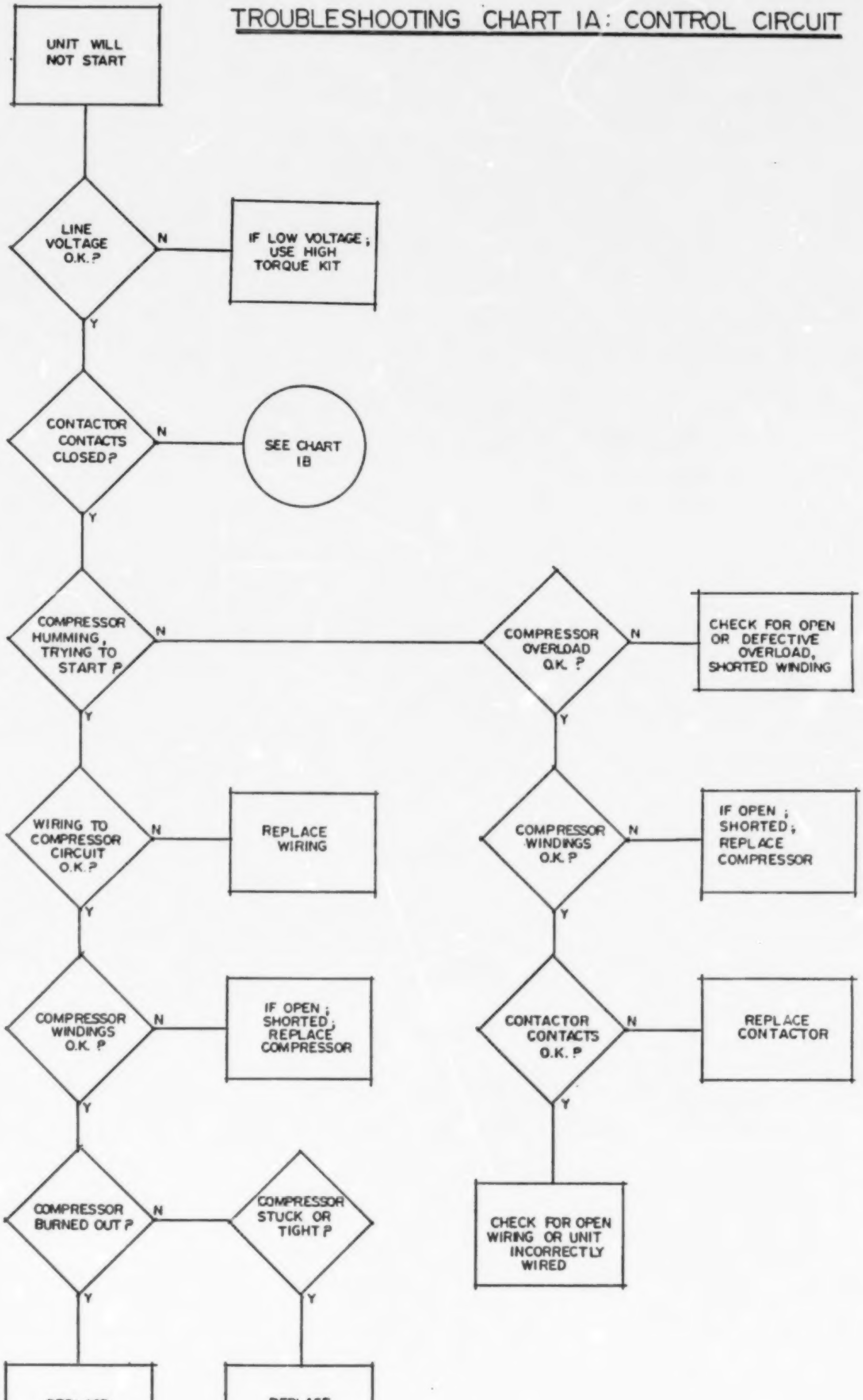
LEGEND

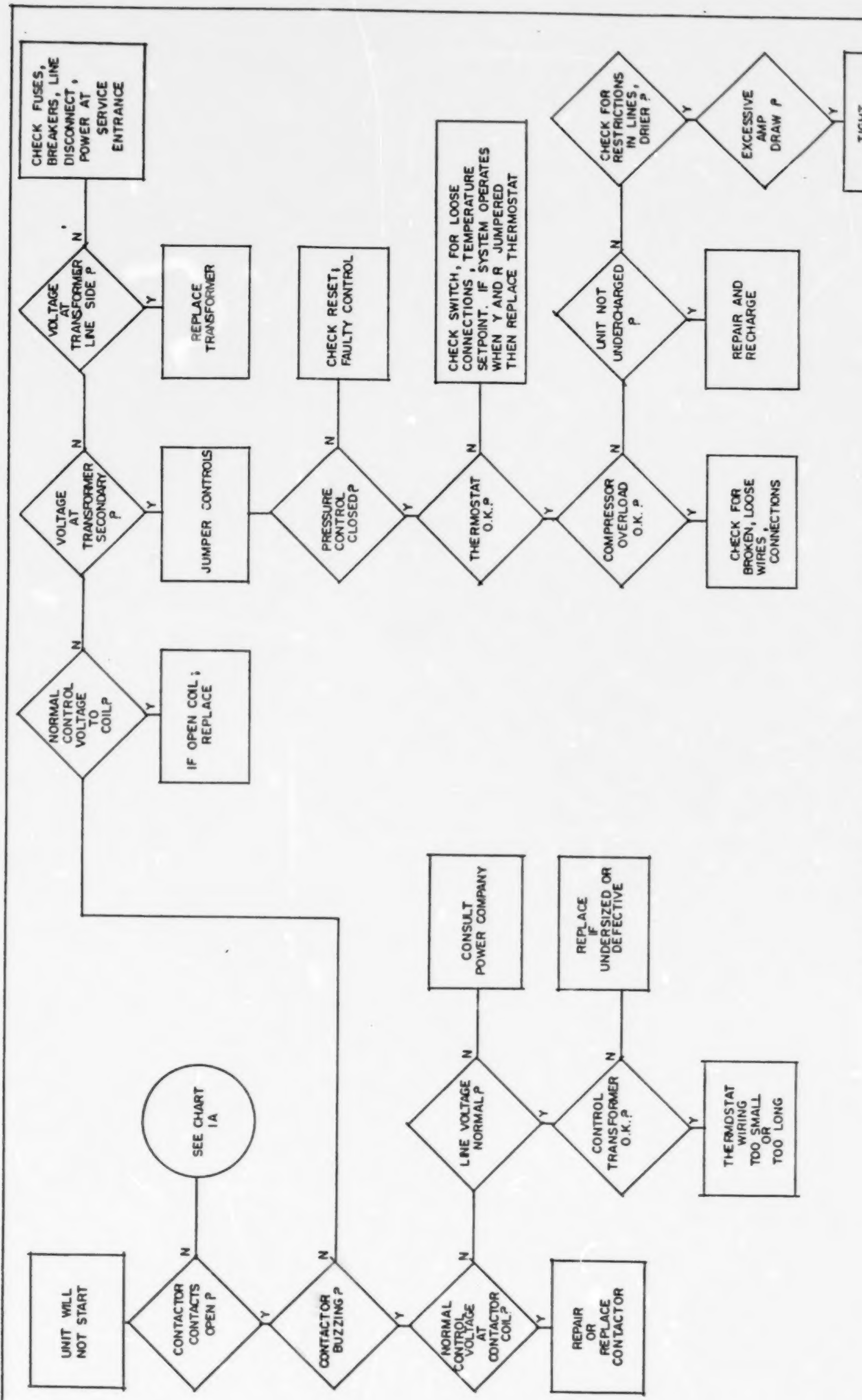
I/O - INTERNALLY PROTECTED MOTOR
CRP - COMPRESSOR RELAY CONTACTS
FRP - FAN RELAY CONTACTS
CRC - COMPRESSOR RELAY COIL
FRC - FAN RELAY COIL
HPC - HIGH PRESSURE CONTROL
LPC - LOW PRESSURE CONTROL (OPTION)

NOTE: FAN MOTOR IS THERMALLY PROTECTED.

DATE: SEPT. 13, 83 ND

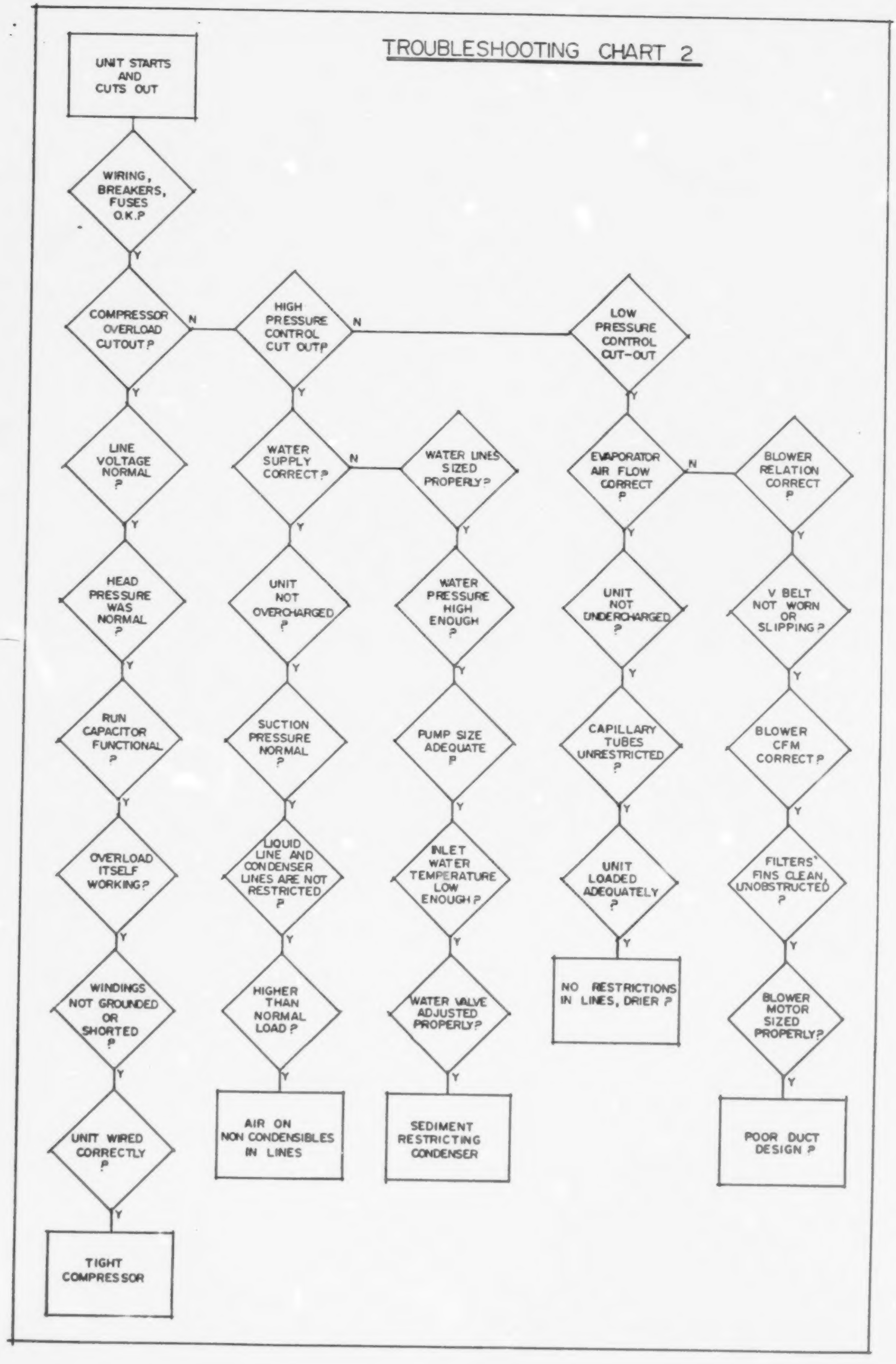
## TROUBLESHOOTING CHART IA: CONTROL CIRCUIT


UNIT WILL NOT START
LINE VOLTAGE O.K.?
N
IF LOW VOLTAGE; USE HIGH TORQUE KIT
Y
CONTACTOR CONTACTS CLOSED?
N
SEE CHART IB
Y
COMPRESSOR HUMMING, TRYING TO START?
N
COMPRESSOR OVERLOAD O.K.?
N
CHECK FOR OPEN OR DEFECTIVE OVERLOAD, SHORTED WINDING
Y
Y
WIRING TO COMPRESSOR CIRCUIT O.K.?
N
REPLACE WIRING
COMPRESSOR WINDINGS O.K.?
N
IF OPEN; SHORTED; REPLACE COMPRESSOR
Y
Y
COMPRESSOR WINDINGS O.K.?
N
IF OPEN; SHORTED; REPLACE COMPRESSOR
CONTACTOR CONTACTS O.K.?
N
REPLACE CONTACTOR
Y
Y
CHECK FOR OPEN WIRING OR UNIT INCORRECTLY WIRED
COMPRESSOR BURNED OUT?
N
COMPRESSOR STUCK OR TIGHT?
Y
Y
REPLACE COMPRESSOR
REPLACE COMPRESSOR


UNIT WILL NOT START
CONTACTOR CONTACTS OPEN ?
N
SEE CHART IA
Y
CONTACTOR BUZZING ?
N
NORMAL CONTROL VOLTAGE TO COIL?
Y
IF OPEN COIL; REPLACE
N
VOLTAGE AT TRANSFORMER SECONDARY ?
N
VOLTAGE AT TRANSFORMER LINE SIDE ?
N
CHECK FUSES, BREAKERS, LINE DISCONNECT, POWER AT SERVICE ENTRANCE
Y
REPLACE TRANSFORMER
Y
JUMPER CONTROLS
PRESSURE CONTROL CLOSED?
N
CHECK RESET; FAULTY CONTROL
Y
THERMOSTAT O.K.?
N
CHECK SWITCH, FOR LOOSE CONNECTIONS, TEMPERATURE SETPOINT. IF SYSTEM OPERATES WHEN Y AND R JUMPERED THEN REPLACE THERMOSTAT
Y
COMPRESSOR OVERLOAD O.K.?
Y
CHECK FOR BROKEN, LOOSE WIRES, CONNECTIONS
N
UNIT NOT UNDERCHARGED ?
Y
REPAIR AND RECHARGE
N
CHECK FOR RESTRICTIONS IN LINES, DRIER ?
Y
EXCESSIVE AMP DRAW ?
Y
TIGHT COMPRESSOR HIGH OR LOW VOLTAGE
Y
NORMAL CONTROL VOLTAGE AT CONTACTOR COIL?
Y
REPAIR OR REPLACE CONTACTOR
N
LINE VOLTAGE NORMAL?
N
CONSULT POWER COMPANY
Y
CONTROL TRANSFORMER O.K.?
N
REPLACE IF UNDERSIZED OR DEFECTIVE
Y
THERMOSTAT WIRING TOO SMALL OR TOO LONG

TROUBLESHOOTING CHART IB: CONTROL CIRCUIT

# TROUBLESHOOTING CHART 2


UNIT STARTS AND CUTS OUT
WIRING, BREAKERS, FUSES O.K.?
Y
COMPRESSOR OVERLOAD CUTOUT?
N
HIGH PRESSURE CONTROL CUT OUT?
N
LOW PRESSURE CONTROL CUT-OUT
Y
LINE VOLTAGE NORMAL ?
Y
HEAD PRESSURE WAS NORMAL ?
Y
RUN CAPACITOR FUNCTIONAL ?
Y
OVERLOAD ITSELF WORKING?
Y
WINDINGS NOT GROUNDED OR SHORTED ?
Y
UNIT WIRED CORRECTLY ?
Y
TIGHT COMPRESSOR
Y
WATER SUPPLY CORRECT?
N
WATER LINES SIZED PROPERLY?
Y
UNIT NOT OVERCHARGED ?
Y
SUCTION PRESSURE NORMAL ?
Y
LIQUID LINE AND CONDENSER LINES ARE NOT RESTRICTED ?
Y
HIGHER THAN NORMAL LOAD?
Y
AIR ON NON CONDENSIBLES IN LINES
Y
WATER PRESSURE HIGH ENOUGH ?
Y
PUMP SIZE ADEQUATE ?
Y
INLET WATER TEMPERATURE LOW ENOUGH?
Y
WATER VALVE ADJUSTED PROPERLY?
Y
SEDIMENT RESTRICTING CONDENSER
Y
EVAPORATOR AIR FLOW CORRECT ?
N
BLOWER RELATION CORRECT ?
Y
UNIT NOT UNDERCHARGED ?
Y
CAPILLARY TUBES UNRESTRICTED ?
Y
UNIT LOADED ADEQUATELY ?
Y
NO RESTRICTIONS IN LINES, DRIER ?
Y
V BELT NOT WORN OR SLIPPING ?
Y
BLOWER CFM CORRECT ?
Y
FILTERS' FINS CLEAN, UNOBSTRUCTED ?
Y
BLOWER MOTOR SIZED PROPERLY?
Y
POOR DUCT DESIGN ?

# REPLACEMENT PARTS LIST

| DESCRIPTION | MODEL NO. | WHERE USED |
|---|---|---|
| **REPLACEMENT COMPRESSORS** | | |
| 230/208/60/1 | Tecumseh AJ5518E-1 | QT-20-1, HQT-20-1 |
| 230/208/60/1 | Tecumseh AB5524F-1 | QT-26-1, HQT-26-1 |
| 230/208/60/1 | Tecumseh AH5531E-1 | QT-33-1, HQT-33-1 |
| 230/208/60/1 | Tecumseh AH5540E-1 | QT-39-1, HQT-39-1 |
| 230/208/60/3 | Tecumseh AH5540E-3 | QT-39-3, HQT-39-3 |
| **RUN CAPACITORS** | | |
| 25MFD, 370V | Tecumseh 85-PR-370E37 | QT-20-1, HQT-20-1 |
| 35MFD, 370V | Tecumseh 85-PR-370E33 | QT-26-1, QT-33-1<br>HQT-26-1, HQT-33-1 |
| 35MFD, 440V | Tecumseh 85-PR-440E34 | QT-39-1, HQT-39-1 |
| **OPTIONAL START CAPACITORS (HI-TORQUE KIT)** | | |
| 22-25 MFD/250V | 1.5 Hi-Torque Kit | QT-20-1, HQT-20-1 |
| 88-106 MFD/250V | 2.5 Hi-Torque Kit | QT-26-1, QT-33-1,<br>HQT-26-1, HQT-33-1 |
| 72-88 MFD/330V | 3 - 5 Hi-Torque Kit | QT-33-1, HQT-33-1 |
| **COMPRESSOR CONTACTORS** | | |
| 24V, 20FLA | Honeywell R8242B-1006 | QT-20-1, QT-26-1<br>QT-33-1, HQT-20-1,<br>HQT-26-1, HQT-33-1 |
| 24V, 30FLA | Honeywell R8243B-1005 | QT-39-1, HQT-39-1 |
| 24V, 25FLA | Honeywell R8210G-1003 | QT-39-3, HQT-39-3 |

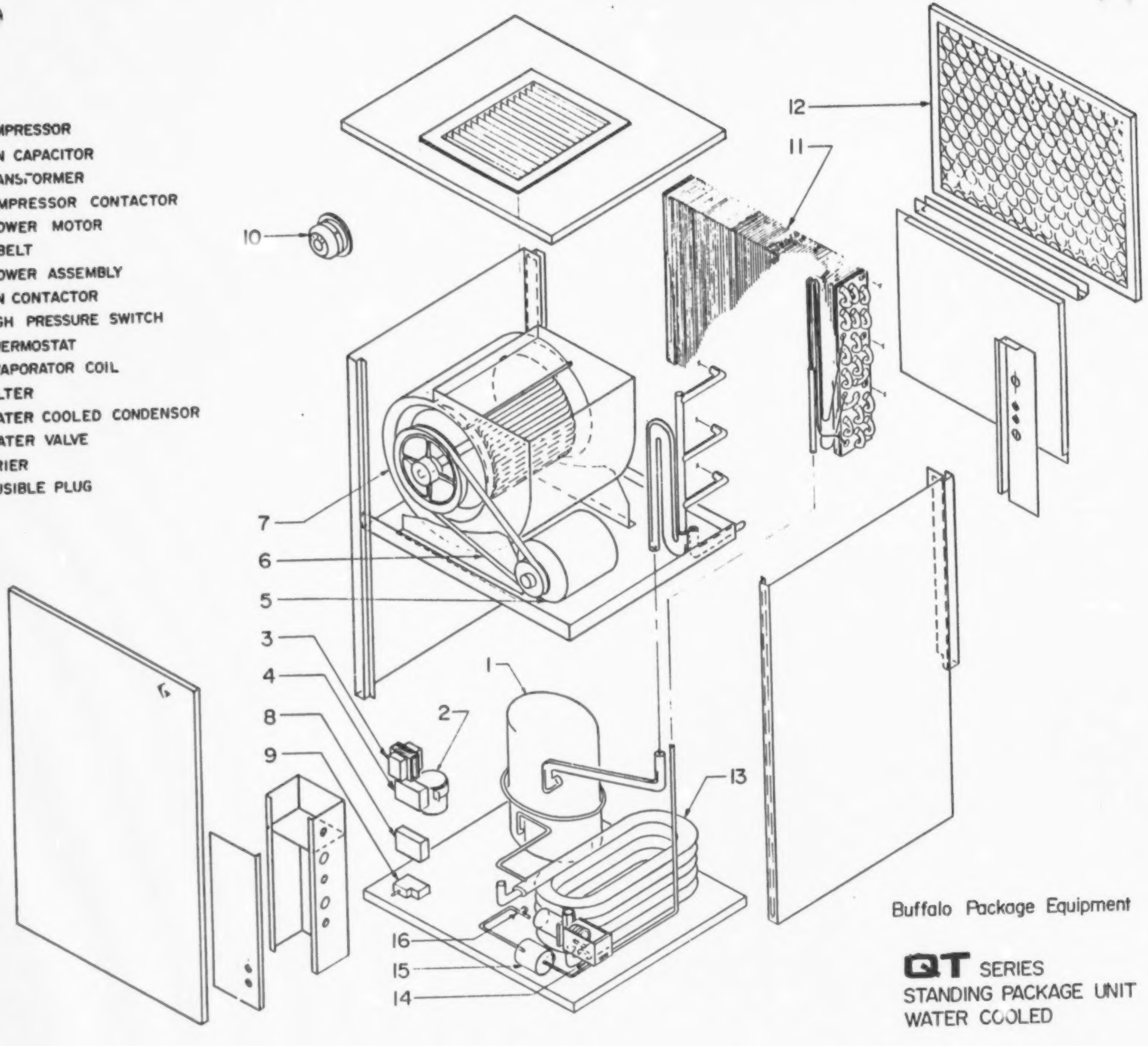
## REPLACEMENT PARTS LIST

| DESCRIPTION | MODEL NO. | WHERE USED |
|---|---|---|
| FAN CONTACTOR<br>24V, 20FLA | Honeywell R8242B-1006 | All QT, HQT units |
| BLOWER MOTOR | | |
| 1/60/208/230V 1/3HP, 1725 RPM | CGE KH-7J471GX | All QT, HQT units |
| Slingers | | All QT, HQT units |
| V Belt 44" A Width | Delhi 4L440 | All QT units |
| BLOWER FAN ASSEMBLY | Delhi G10 Fan c/w Uni-Kit | All QT units |
| | Delhi G9-7 c/w Uni-kit | HQT-20-1, HQT-26-1 |
| | Delhi G9 Fan c/w Uni-kit | HQT-33-1, HQT-39-1<br>HQT-39-3 |
| TRANSFORMER<br>240V - 24V, 40VA | Honeywell AT72D1105 | All QT, HQT units |
| HIGH-PRESSURE SWITCH | Honeywell P430B-1065<br>Penn Johnson P20DB-1 | All QT, HQT units |
| OPTIONAL THERMOSTAT | Honeywell T87F2881 | All QT, HQT units |
| Sub-base | Honeywell Q539C1020 | All QT, HQT units |

## REPLACEMENT PARTS LIST

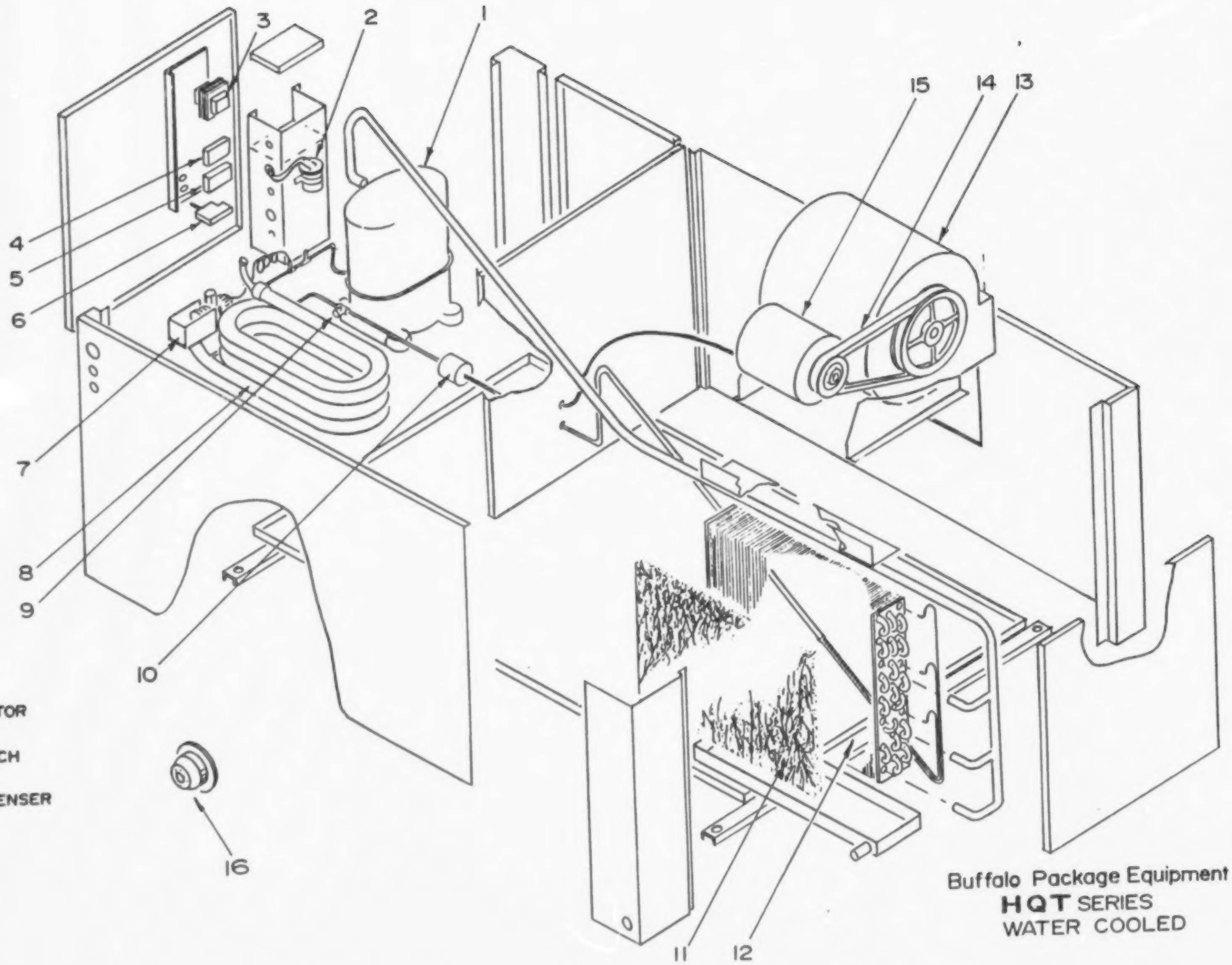
| DESCRIPTION | MODEL NO. | WHERE USED |
|---|---|---|
| EVAPORATORS | | |
| EVAPORATOR COIL | BPE #21023 | QT-20-1, HQT-20-1 |
| EVAPORATOR COIL | BPE #21025 | QT-26-1, HQT-26-1 |
| EVAPORATOR COIL | BPE #21027 | QT-33-1, QT-39-1, QT-39-3, HQT-33-1, HQT-39-1, HQT-39-3 |
| FILTER | 20" x 25" disposable | All QT units |
| FILTER | 21" x 16" permanent | All HQT units |
| CONDENSERS | | |
| CONDENSER, WATER COOLED 1-1/2 and 2 ton | BPE #21200 | QT-20-1, QT-26-1<br>HQT-20-1, HQT-26-1 |
| CONDENSER, WATER COOLED 2-1/2 ton | BPE #21202 | QT-33-1, HQT-33-1 |
| CONDENSER, WATER COOLED 3 and 4 ton | BPE #21204 | QT-39-1, QT-39-3<br>HQT-39-1, HQT-39-3 |
| WATER VALVE 3/8" | Penn Baso V46AA-1 | All QT, HQT units |
| DRIER | Mueller SD-033<br>ALCO EK-033S | QT-20-1, QT-26-1, QT-33-1, HQT-20-1, HQT-26-1, HQT-33-1 |
| DRIER | Mueller SD-053<br>ALCO EK-053S | QT-39-1, QT-39-3<br>HQT-39-1, HQT-39-3 |
| FUSIBLE PLUG | Mueller A14021 | All QT, HQT units |

1 - COMPRESSOR
2 - RUN CAPACITOR
3 - TRANSFORMER
4 - COMPRESSOR CONTACTOR
5 - BLOWER MOTOR
6 - V-BELT
7 - BLOWER ASSEMBLY
8 - FAN CONTACTOR
9 - HIGH PRESSURE SWITCH
10 - THERMOSTAT
11 - EVAPORATOR COIL
12 - FILTER
13 - WATER COOLED CONDENSOR
14 - WATER VALVE
15 - DRIER
16 - FUSIBLE PLUG



Buffalo Package Equipment

**QT** SERIES
STANDING PACKAGE UNIT
WATER COOLED



1 - COMPRESSOR
2 - RUN CAPACITOR
3 - TRANSFORMER
4 - COMPRESSOR CONTACTOR
5 - FAN CONTACTOR
6 - HIGH PRESSURE SWITCH
7 - WATER VALVE
8 - WATER COOLED CONDENSER
9 - FUSIBLE PLUG
10 - DRIER
11 - FILTER
12 - EVAPORATOR COIL
13 - BLOWER ASSEMBLY
14 - V-BELT
15 - BLOWER MOTOR
16 - THERMOSTAT

Buffalo Package Equipment
**HQT** SERIES
WATER COOLED

RSZABO MAR. 66

**Climate Master**

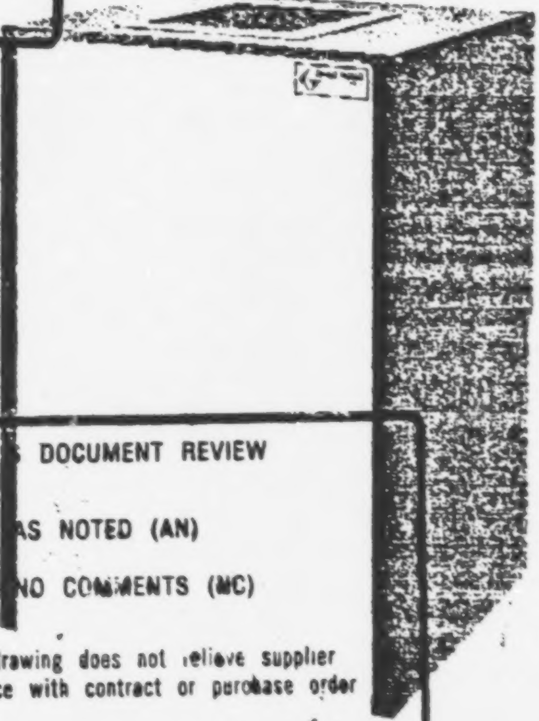
# QT SERIES
## STANDING PACKAGE UNIT
## WATER COOLED
## 1 to 3 TON

PROJ:

| | JOB No. | PURCH. ORDER No. | | | V.P. No. | REV. |
|---|---|---|---|---|---|---|
| V.P. | A149-15 | SC | 002 | | 3 | 0 |

EQUIP. No.

Kilborn



### REDESIGNED WITH THESE NEW FEATURES:

**Superior Serviceability**

- Larger front access panel provides front blower access
- Ground joint union facilitates changing of water valve
- New electrical box for easier access
- Two-piece rear access panel incorporates one panel for water connections and one removable panel

**New Look**

- One-piece cabinet
- Two-tone color scheme (beige/brown)
- New filter frame with removable top clip

VENDOR'S DOCUMENT REVIEW

☑ REVIEWED - AS NOTED (AN)

☐ REVIEWED - NO COMMENTS (NC)

"REVIEW of this drawing does not relieve supplier from full compliance with contract or purchase order requirements".

By ______ Date Nov 23/87

Kilborn

This quiet water-cooled package offers maximum flexibility for the difficult interior zone air conditioning applications.

The unit is water cooled, thus eliminating condenser fan noise. The QT Series is highly recommended for computer rooms, hospitals, dental labs, or any institution where noise level is critical.

The compact features of the QT Series permit installation in offices where space is at a premium. Typical locations include closets, between desks or cabinets, or in an unused corner of the office.

Neutral color scheme and inobtrusive installation make the QT Series suitable for any office decor.

# GENERAL INFORMATION

**CABINET:**

Built of satin coat sheet steel. Access panels are quickly and easily removed. Four adjustable legs are provided with each unit.

**APPLICATION:**

Principally utilized in interior zones and where noise level is an important factor in equipment selection. This unit is designed for either free blow or duct connection.

**CONTROLS:**

Factory wired and installed. Include a magnetic contactor, relay, transformer, high pressure control and mounted automatic water valve. Operation of the QT unit requires a 24-volt remote cooling thermostat and subbase which must be ordered separately.

SPECIFIED

**COMPRESSOR:**

Compressors have both thermal and current overload devices. The compressors are internally spring mounted and are also equipped with the refrigerant anti-slug device.

**CONDENSER:**

Co-axial (tube within tube) refrigerant condenser made of finned copper inner tube and outer steel shell.

**EVAPORATOR BLOWER:**

Factory mounted belt drive centrifugal fan with permanently oiled bearings, thermally protected, resilient mounted motor with oil bearings. Variable pitch drive motor pulley.

Factory mounted direct drive centrifugal fan with multi-speed fan motor is standard equipment on the QT-13-1.

**FILTER SECTION:**

Slide-in rack with 1" disposable type filter.

**EVAPORATOR COIL:**

Copper tubing mechanically expanded into aluminum fins, capillary tube distribution system, leak tested and dehydrated.

**FILTER-DRIER:**

Factory installed and selected for maximum system protection.

**REFRIGERANT AND OIL:**

Both liquid and suction lines are equipped with Schrader access fittings. The recommended operating charge of oil is included.

# GENERAL SPECIFICATIONS

Imperial

| MODEL | QT-13-1 | QT-20-1 | QT-26-1 | QT-33-1 | QT-39-1 | QT-39-3 |
|---|---|---|---|---|---|---|
| Capacity - BTU/h* | ~~13,200~~ | ~~19,600~~ | ~~25,750~~ | 32,850 | ~~39,125~~ | ~~39,125~~ |
| Nominal Capacity - tons | ~~1~~ | ~~1 1/2~~ | ~~2~~ | 2 1/2 | ~~3~~ | ~~3~~ |
| Factory Refrig. Charge - oz. R-22 | ~~30~~ | ~~36~~ | ~~37~~ | 38 | ~~52~~ | ~~52~~ |
| Shipping Weight - Lbs. | ~~170~~ | ~~235~~ | ~~250~~ | 260 | ~~270~~ | ~~270~~ |
| COMPRESSOR Type | ~~Tecumseh AK8513E~~ | ~~Tecumseh AJ5518E~~ | ~~Tecumseh AB5524F~~ | Tecumseh AH5531E | ~~Tecumseh AH5540E~~ | ~~Tecumseh AH5540E~~ |
| EVAPORATOR COIL Size - in. | ~~15 1/2 x 16~~ | ~~20 1/2 x 16~~ | ~~20 1/2 x 14~~ | 20 1/2 x 16 | ~~20 1/2 x 16~~ | ~~20 1/2 x 16~~ |
| Face Area - sq. ft. | ~~1.7~~ | ~~2.0~~ | ~~2.0~~ | 2.3 | ~~2.3~~ | ~~2.3~~ |
| Copper Tubing - "O.D. | ~~3/8~~ | ~~3/8~~ | ~~3/8~~ | 3/8 | ~~3/8~~ | ~~3/8~~ |
| Rows Deep | ~~2~~ | ~~2~~ | ~~3~~ | 3 | ~~3~~ | ~~3~~ |
| Fins Per Inch | ~~14~~ | ~~14~~ | ~~14~~ | 14 | ~~14~~ | ~~14~~ |
| EVAPORATOR FAN Size - In. | ~~9 x 7 D.D.~~ | ~~9 x 7~~ | ~~9 x 7~~ | 9 x 9 | ~~9 x 9~~ | ~~9 x 9~~ |
| Motor Size - Hp | ~~**1/4, 1/6, 1/8~~ | ~~1/3~~ | ~~1/3~~ | 1/3 | ~~1/3~~ | ~~1/3~~ |
| Motor Rating - R.L.A. | ~~1.6~~ | ~~3.2~~ | ~~3.2~~ | 3.2 | ~~3.2~~ | ~~3.2~~ |
| Airflow - C.F.M. | ~~400~~ | ~~600~~ | ~~800~~ | 1000 | ~~1200~~ | ~~1200~~ |

*At A.R.I. Std. Cond.
-67°F wb, 80°F db on evaporator
-75°F water entering, 95°F water leaving condenser

**3 speed direct drive motor
Factory set at 1/8 h.p.

# PERFORMANCE DATA at selected conditions*

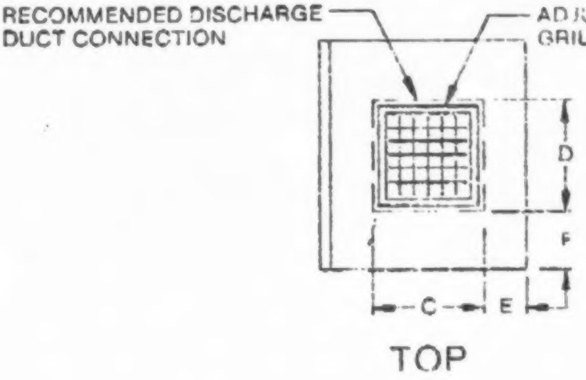
| CONDENSER | | | | | EVAPORATOR | COOLING CAPACITIES (BTU/h) | | |
|---|---|---|---|---|---|---|---|---|
| MODEL | INLET WATER TEMP. (°F) | OUTLET WATER TEMP. (°F) | WATER FLOW RATE (GPM) | UNIT PRESSURE DROP AT FULL WATER FLOW (PSIG) | AIR FLOW RATE (CFM) | TOTAL | SENSIBLE at 80°F DRY BULB | HEAD PRESSURE (PSIG) |
| QT-13-1 | 55<br>75 | 99<br>96 | .5<br>1.0 | 1<br>2 | 400 | 13,400<br>13,200 | 8,915<br>8,830 | 250<br>200 |
| QT-20-1 | 55<br>75<br>75 | 103<br>95<br>85 | 0.85<br>2.5<br>3.5 | 2<br>7<br>10 | 600 | 18,600<br>19,600<br>20,000 | 12,200<br>12,300<br>12,470 | 250<br>210<br>200 |
| QT-26-1 | 55<br>75<br>75 | 104<br>95<br>85 | 1.1<br>3.0<br>4.0 | 3<br>8<br>10 | 800 | 26,500<br>25,750<br>26,250 | 16,500<br>16,280<br>16,450 | 250<br>225<br>205 |
| QT-33-1 | 55<br>75<br>75 | 98<br>95<br>85 | 1.7<br>3.5<br>5.5 | 3<br>12<br>22 | 1000 | 34,150<br>32,850<br>34,000 | 21,200<br>20,850<br>21,400 | 250<br>230<br>210 |
| QT-39-1<br>QT-39-3 | 55<br>75<br>75 | 103<br>95<br>85 | 1.7<br>4.5<br>6.5 | 5<br>12<br>22 | 1200 | 39,000<br>39,125<br>39,000 | 25,725<br>25,850<br>25,725 | 250<br>230<br>220 |

EVAPORATOR: 80°F dry bulb; 67°F wet bulb
*For capacities at other conditions, contact sales representative

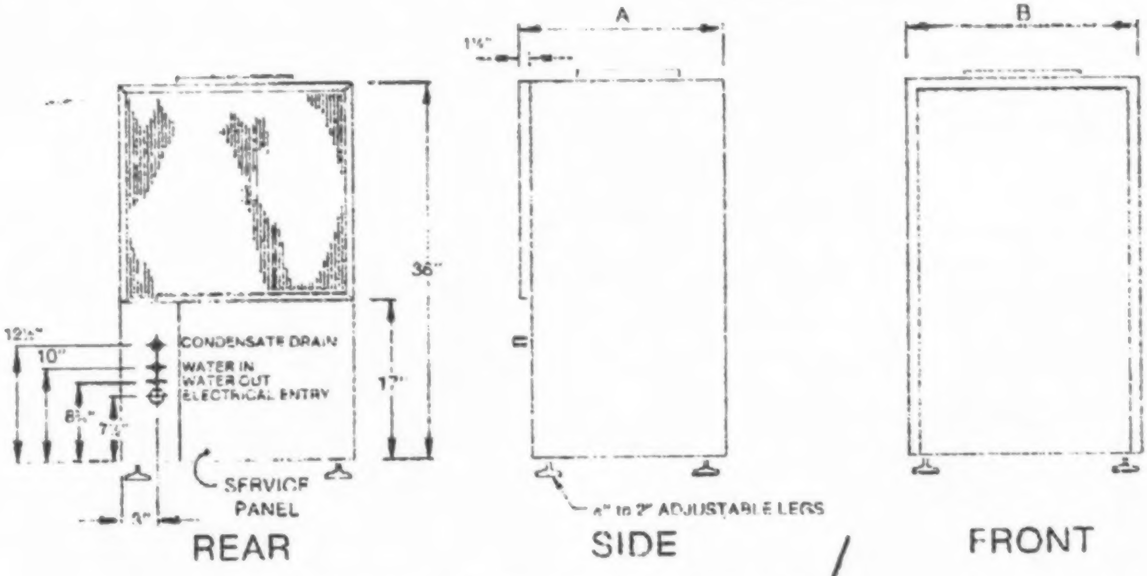
**Note:** QT units are shipped with water valve set at 250 PSIG condensing pressure. This setting will result in minimum water consumption.
Setting the water valve for lower condensing pressure will increase water consumption but improve the unit's efficiency.

# DIMENSIONS

## Imperial


RECOMMENDED DISCHARGE DUCT CONNECTION
ADJUSTABLE DISCHARGE GRILL
D
F
C
E
TOP

| DIMENSIONS | | | CONNECTION SIZES | |
|---|---|---|---|---|
| | QT-13-1 | QT-20<br>QT-26<br>QT-33<br>QT-39 | | |
| A | 21⅛ | 22⅜ | | |
| B | 20 | 25 | Condensate Drain | ¾" O.D. |
| C | 13 | 15 | Water Supply | ⅜" F.P.T. |
| D | 15 | 13 | Water Outlet | ⅜" O.D. |
| E | 3½ | 1⅝ | Electrical Entry | 1½" ø |
| F | 6 | 6 | | |


A
1¼"
B
36"
12½"
10"
8¾"
7½"
17"
3"
CONDENSATE DRAIN
WATER IN
WATER OUT
ELECTRICAL ENTRY
SERVICE PANEL
½" to 2" ADJUSTABLE LEGS
REAR
SIDE
FRONT

# ELECTRICAL CHARACTERISTICS

| MODEL | QT-13-1 | QT-20-1 | QT-26-1 | QT-33-1 | QT-39-1 | QT-39-3 |
|---|---|---|---|---|---|---|
| POWER SUPPLY Volts | 240/208 | 240/208 | 240/208 | 240/208 | 240/208 | 240/208 |
| Phase | 1 | 1 | 1 | 1 | 1 | 3 |
| Cycle | 60 | 60 | 60 | 60 | 60 | 60 |
| COMPRESSOR R.P.M. | 3400 | 3400 | 3400 | 3400 | 3400 | 3400 |
| R.L.A. | 5.8 | 10.5 | 12.2 | 17.5 | 22.3 | 12.5 |
| L.R.A. | 31 | 53 | 64 | 75 | 103 | 72 |
| EVAPORATOR FAN R.P.M. | *multi-speed* | 1725 | 1725 | 1725 | 1725 | 1725 |
| H.P. | *1/4, 1/6, 1/8 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| F.L.A. | 1.6 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |

**NOTE:** In our continuing process of product development, we reserve the right to change product specifications without notice. For updated information and/or changes, consult certified shop drawings

*3 speed direct drive motor.
Factory set at 1/8 h.p.

**EngA** ENGINEERED AIR

# MAINTENANCE INSTRUCTIONS

# FOR

# ENG A HYDRONIC HEATING AND COOLING EQUIPMENT

## FINNED TUBE RADIATION (All Styles)

No maintenance is required, other than to vacuum out dust from the heating element annually.

NOTE: Care must be taken not to deform the fins during cleaning.

## CABINET UNIT HEATERS AND FAN-COIL UNITS (All Models)

No maintenance is required, other than to clean the coil fins annually. Motors are permanently lubricated and should require no maintenance for 5,000 hours. Should a motor require lubrication, only S.A.E. 20 oil should be used. Filters may be supplied with these units. If so, these should be cleaned or replaced each heating season.

NOTE: During any work on these units, care must be taken not to damage the aluminum fins.

ALWAYS DISCONNECT ELECTRICAL SERVICES WHEN WORKING ON ANY UNIT.

## UNIT HEATERS (Vertical and Horizontal Models)

No maintenance is required, other than to clean the coil fins annually. Motors are permanently lubricated and should require no maintenance for 5,000 hours. Should a motor require lubrication, only S.A.E. 20 oil should be used. In dirty areas, such as welding shops, periodic inspections and cleaning of heating coils and fan blades should be made.

NOTE: During any work on these units, care must be taken not to damage the aluminum fins.

ALWAYS DISCONNECT ELECTRICAL SERVICES WHEN WORKING ON ANY UNIT.

FLOOR

## HORIZONTAL, VERTICAL, AND CABINET UNIT HEATERS ROOM SCHEDULE

PAGE / OF /

| ROOM | TYPE ON PLAN | QTY | MODEL | ARRGT | CAPACITY | FLOW RATE | PRESS DROP | AIR FLOW | S.P. | MOTOR EXP. PROOF. | | | ACCESSORIES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | RATING | RPM | AMPS 115/1/60 | DIFFUSER FOUR WAY | DIFFUSER LOUVRE CONE | 3 SPD CTRL UNIT MTD | 3 SPD CTRL REMOTE MTD | STARTER UNIT MTD | STARTER REMOTE MTD | THERMOSTAT UNIT MTD | THERMOSTAT REMOTE MTD | ACCESS DOOR RIGHT | ACCESS DOOR LEFT | ACOUSTIC INSULATION | FAN GUARD |
| | UH-1 | 1 | H-10 | | 50.7 | 1.22 | 8.4 | 1897 | | .373 | 1140 | 9.4 | ✓ | | | | | | | | | | | |
| | UH-2 | 1 | H-10 | | 50.7 | 1.22 | 8.4 | 1897 | | .373 | 1140 | 9.4 | ✓ | | | | | | | | | | | |

C/W EXPLOSION PROOF LINE VOLTAGE THERMOSTAT.

PROJ:

| V:P. | JOB No. | PURCH. ORDER No. | | | V.P. No. | REV. |
|---|---|---|---|---|---|---|
| | A149-15 | SC | 002 | 3 | 2 | 0 |

EQUIP. No. UH-1 & 2.

Kilborn

VENDOR'S DOCUMENT REVIEW

☑ REVIEWED - AS NOTED (AN)

☐ REVIEWED - NO COMMENTS (NC)

"REVIEW of this drawing does not relieve supplier from full compliance with contract or purchase order requirements".

By JEHaack Date 87 11 23.

Kilborn

CONTRACTOR: FILAX MECH.
CONT. P.O. NO.:
ENGINEER: Kilborn
DATE:
REVISION NO.:
REF. DWGS.:

ENT. WATER TEMP.: 90.6
WATER TEMP. DROP: 17
AVG. WATER TEMP.: 82.2
STEAM PRESS.:
COND. RATE:
ENT. AIR TEMP.:

**EngA** ENGINEERED AIR

PROJECT: DEVON COAL RESEARCH

ORDER NO.:

FORM NO. UH 04/85

# EngA

## HORIZONTAL UNIT HEATERS
## PERFORMANCE DATA

ALL DATA FOR 16°C ENTERING AIR TEMPERATURE

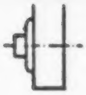
| MODEL NO. FLOW RATE | MOTOR | | WATER T.D.C° | 93° C E W T | | | 82° C E W T | | | 71° C E W T | | | 13.8 kPa STEAM | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WATTS (AMPS) | RPM | | kW | l/s | kPa | kW | l/s | kPa | kW | l/s | kPa | kW | kg/hr |
| H 1<br>260 l/s | 37 (1.6) | 1550 | 6 | 8.0 | 0.35 | 4.2 | 6.8 | 0.28 | 2.4 | 5.6 | 0.23 | 2.1 | 11.5 | 18.4 |
| | | | 11 | 7.4 | 0.16 | 0.9 | 6.2 | 0.13 | 0.6 | 5.0 | 0.10 | 0.3 | | |
| | | | 17 | 6.9 | 0.10 | 0.3 | 5.7 | 0.09 | 0.3 | 4.5 | 0.06 | 0.1 | | |
| | | | 22 | 6.5 | 0.08 | 0.3 | 5.4 | 0.08 | 0.1 | 4.3 | 0.04 | 0.1 | | |
| H 2<br>293 l/s | 37 (1.6) | 1550 | 6 | 10.6 | 0.44 | 5.4 | 9.0 | 0.39 | 4.5 | 7.3 | 0.30 | 2.7 | 15.1 | 24.2 |
| | | | 11 | 9.7 | 0.20 | 1.5 | 8.1 | 0.17 | 0.9 | 6.6 | 0.13 | 0.6 | | |
| | | | 17 | 9.1 | 0.13 | 0.6 | 7.6 | 0.11 | 0.3 | 6.2 | 0.09 | 0.3 | | |
| | | | 22 | 8.6 | 0.09 | 0.3 | 7.2 | 0.08 | 0.2 | 5.7 | 0.08 | 0.1 | | |
| H 3<br>396 l/s | 62 (2.4) | 1550 | 6 | 13.4 | 0.58 | 6.6 | 11.3 | 0.47 | 4.2 | 9.2 | 0.38 | 3.0 | 18.8 | 30.2 |
| | | | 11 | 12.1 | 0.26 | 1.5 | 10.1 | 0.21 | 0.9 | 8.1 | 0.17 | 0.6 | | |
| | | | 17 | 11.3 | 0.16 | 0.6 | 9.3 | 0.13 | 0.3 | 7.3 | 0.10 | 0.3 | | |
| | | | 22 | 10.5 | 0.11 | 0.3 | 8.8 | 0.09 | 0.2 | 6.9 | 0.08 | 0.1 | | |
| H 4<br>472 l/s | 62 (2.4) | 1550 | 6 | 17.0 | 0.74 | 9.0 | 14.2 | 0.59 | 6.0 | 11.7 | 0.51 | 4.8 | 24.0 | 38.5 |
| | | | 11 | 15.5 | 0.33 | 2.1 | 12.9 | 0.25 | 1.2 | 10.5 | 0.23 | 1.2 | | |
| | | | 17 | 14.4 | 0.21 | 0.9 | 12.0 | 0.14 | 0.6 | 9.7 | 0.15 | 0.6 | | |
| | | | 22 | 13.6 | 0.15 | 0.3 | 11.3 | 0.11 | 0.3 | 9.0 | 0.10 | 0.3 | | |
| H 5<br>585 l/s | 124 (6.0) | 1050 | 6 | 19.7 | 0.86 | 12.6 | 16.6 | 0.73 | 9.0 | 13.6 | 0.63 | 7.2 | 27.5 | 44.1 |
| | | | 11 | 17.7 | 0.38 | 2.4 | 14.7 | 0.30 | 1.8 | 11.9 | 0.26 | 1.2 | | |
| | | | 17 | 16.4 | 0.23 | 0.9 | 13.6 | 0.20 | 0.6 | 11.0 | 0.17 | 1.2 | | |
| | | | 22 | 15.4 | 0.16 | 0.6 | 12.7 | 0.15 | 0.3 | 10.2 | 0.14 | 0.3 | | |
| H 6<br>698 l/s | 124 (6.0) | 1050 | 6 | 24.5 | 1.04 | 13.7 | 20.6 | 0.89 | 9.6 | 16.9 | 0.76 | 6.6 | 34.2 | 54.9 |
| | | | 11 | 22.0 | 0.47 | 2.4 | 17.8 | 0.32 | 1.2 | 14.4 | 0.50 | 0.9 | | |
| | | | 17 | 20.4 | 0.29 | 0.9 | 16.9 | 0.24 | 0.6 | 13.7 | 0.21 | 0.6 | | |
| | | | 22 | 19.1 | 0.20 | 0.6 | 15.8 | 0.18 | 0.3 | 12.7 | 0.14 | 0.3 | | |
| H 7<br>831 l/s | 124 (6.0) | 1050 | 6 | 33.6 | 1.42 | 18.5 | 28.2 | 1.19 | 13.5 | 23.1 | 1.00 | 10.2 | 47.4 | 76.1 |
| | | | 11 | 30.6 | 0.64 | 3.9 | 25.4 | 0.51 | 3.0 | 20.5 | 0.44 | 1.8 | | |
| | | | 17 | 28.5 | 0.42 | 1.5 | 23.6 | 0.34 | 0.9 | 19.1 | 0.28 | 0.6 | | |
| | | | 22 | 26.8 | 0.28 | 0.6 | 22.2 | 0.24 | 0.6 | 17.8 | 0.20 | 0.3 | | |
| H 8<br>1076 l/s | 187 (3.7) | 1050 | 6 | 38.8 | 1.67 | 19.7 | 32.6 | 1.42 | 16.7 | 26.7 | 1.22 | 13.5 | 50.8 | 81.5 |
| | | | 11 | 35.0 | 0.75 | 3.9 | 29.0 | 0.64 | 3.6 | 23.5 | 0.52 | 3.0 | | |
| | | | 17 | 32.3 | 0.47 | 1.8 | 26.8 | 0.35 | 1.2 | 21.7 | 0.33 | 1.2 | | |
| | | | 22 | 30.3 | 0.33 | 0.9 | 25.1 | 0.24 | 0.6 | 20.0 | 0.20 | 0.6 | | |
| H 9<br>1619 l/s | 373 (7.1) | 1050 | 6 | 48.5 | 2.09 | 29.3 | 40.8 | 1.79 | 29.0 | 33.4 | 1.59 | 23.6 | 62.1 | 99.8 |
| | | | 11 | 42.9 | 0.92 | 5.7 | 35.6 | 0.76 | 5.4 | 28.9 | 0.64 | 4.5 | | |
| | | | 17 | 39.2 | 0.56 | 2.1 | 32.6 | 0.42 | 2.1 | 26.4 | 0.41 | 1.8 | | |
| | | | 22 | 36.7 | 0.40 | 1.2 | 30.5 | 0.32 | 0.6 | 24.4 | 0.29 | 0.6 | | |
| H 10<br>1897 l/s | 373 (7.1) | 1050 | 6 | 64.0 | 2.75 | 41.5 | 53.7 | 2.38 | 31.7 | 44.1 | 2.15 | 28.1 | 79.5 | 127.8 |
| | | | 11 | 56.8 | 1.22 | 8.4 | 47.1 | 0.98 | 5.4 | 38.2 | 0.80 | 4.5 | | |
| | | | 17 | 52.4 | 0.75 | 3.0 | 43.5 | 0.63 | 2.4 | 34.8 | 0.50 | 1.5 | | |
| | | | 22 | 48.7 | 0.52 | 1.5 | 40.4 | 0.47 | 1.5 | 32.3 | 0.39 | 0.9 | | |
| H 11<br>2100 l/s | 373 (7.1) | 1050 | 6 | 78.8 | 3.39 | 53.8 | 66.2 | 2.88 | 38.3 | 54.3 | 2.62 | 32.3 | 98.2 | 157.3 |
| | | | 11 | 70.1 | 1.51 | 10.8 | 58.2 | 1.19 | 6.6 | 47.1 | 1.00 | 4.5 | | |
| | | | 17 | 65.4 | 0.94 | 4.2 | 54.3 | 0.81 | 3.6 | 44.0 | 0.71 | 2.4 | | |
| | | | 22 | 61.1 | 0.66 | 2.1 | 50.7 | 0.57 | 1.5 | 40.6 | 0.49 | 1.2 | | |

HUM 2M 12/85

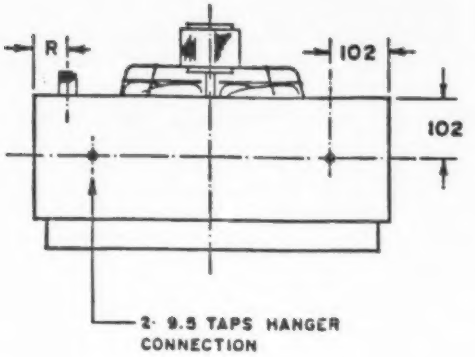
NOTE: AIR TEMPERATURE RISE (°C) = 829 x kW ÷ l/s
WATER TEMPERATURE DROP (°C) = 0.24 x kW ÷ l/s

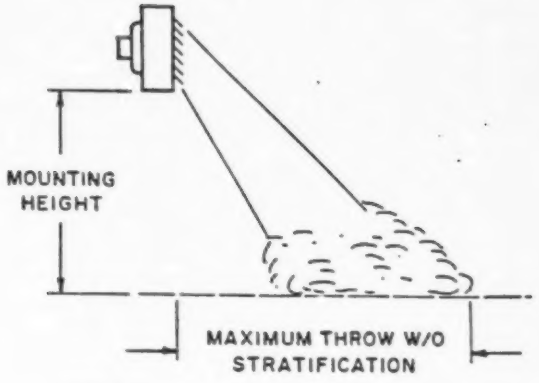
FOR ALTERNATE OPERATING CONDITIONS REFER TO DWG UH-1M

**EngA**



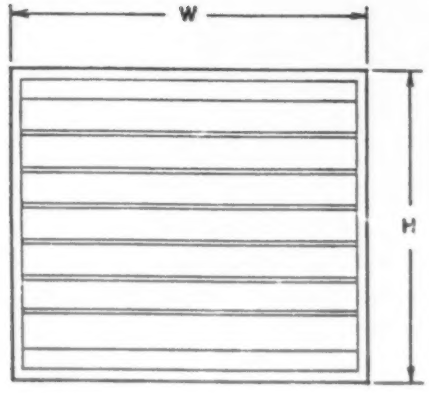
# MODEL H HORIZONTAL UNIT HEATERS ROUGHING IN DIMENSIONS

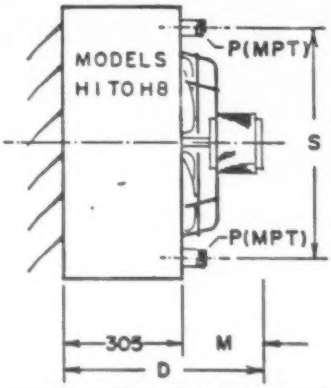

R
102
102
2- 9.5 TAPS HANGER CONNECTION

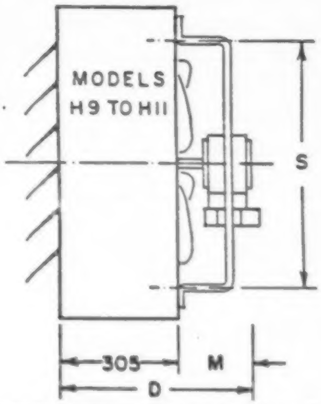

MOUNTING HEIGHT
MAXIMUM THROW W/O STRATIFICATION

NOTE:

THE FIGURES GIVEN FOR HORIZONTAL THROW IN THE TABLE BELOW INDICATE THE NECESSITY TO DIRECT AIR FLOW DOWNWARDS WITH THE HORIZONTAL LOUVRES WITH HIGH DISCHARGE AIR TEMPERATURES, WHILE COOLER DISCHARGE TEMPERATURES ALLOW A FLATTER, LONGER THROW WITHOUT STRATIFICATION.




MODELS H1 TO H8
P(MPT)
P(MPT)
S
305
M
D


MODELS H9 TO H11
S
305
M
D

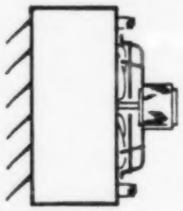
| MODEL NO. | H | W | D | M | R | S | P MPT | NOISE LEVEL | MASS kg | MAX. MTG. HEIGHT | HORIZONTAL THROW ( m ) LEAVING AIR TEMP °C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 24° | 38° | 52° | 66° |
| H 1 | 495 | 533 | 470 | 165 | 76 | 352 | 25 | LOW | 40 | 2.7 | 8.2 | 7.3 | 6.7 | 5.2 |
| H 2 | 559 | 610 | 470 | 165 | 76 | 416 | 25 | LOW | 43 | 2.7 | 10.7 | 9.1 | 8.2 | 6.4 |
| H 3 | 559 | 610 | 495 | 191 | 76 | 416 | 25 | LOW | 45 | 2.7 | 11.3 | 9.8 | 8.8 | 6.7 |
| H 4 | 622 | 686 | 495 | 191 | 73 | 479 | 32 | LOW | 51 | 3.0 | 12.1 | 10.7 | 9.8 | 7.3 |
| H 5 | 622 | 686 | 549 | 244 | 73 | 479 | 32 | MED | 59 | 3.4 | 13.4 | 11.6 | 10.7 | 7.9 |
| H 6 | 686 | 737 | 549 | 244 | 70 | 543 | 38 | MED | 67 | 3.4 | 14.0 | 12.2 | 11.3 | 8.5 |
| H 7 | 813 | 864 | 549 | 244 | 70 | 670 | 38 | MED | 82 | 3.4 | 14.9 | 13.1 | 11.9 | 9.1 |
| H 8 | 813 | 864 | 552 | 248 | 70 | 670 | 38 | MED | 88 | 3.7 | 16.4 | 14.3 | 13.1 | 10.1 |
| H 9 | 813 | 864 | 578 | 273 | 70 | 670 | 38 | HIGH | 107 | 4.0 | 17.1 | 14.9 | 13.7 | 10.4 |
| H 10 | 940 | 961 | 578 | 273 | 73 | 797 | 51 | HIGH | 129 | 4.3 | 18.6 | 16.2 | 14.9 | 11.3 |
| H 11 | 1067 | 1118 | 559 | 254 | 73 | 924 | 51 | HIGH | 150 | 4.6 | 20.4 | 17.7 | 16.2 | 12.5 |

**EngA**

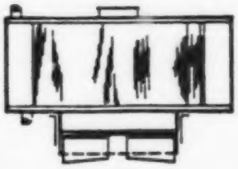
# CAPACITY CONVERSION FACTORS

(APPLY TO 93° EWT OR 13.8 kPa STEAM AND 16° EAT)

## MODEL H HORIZONTAL DISCHARGE ( BLOW THROUGH ) UNITS

| | | ENTERING AIR TEMPERATURE ° C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -23 | -18 | -12 | -7 | -1 | 4 | 10 | 16 | 21 | 27 | 32 | 38 |
| STEAM PRESSURE kPa | 0 | 1.54 | 1.45 | 1.37 | 1.27 | 1.19 | 1.11 | 1.03 | 0.96 | 0.88 | 0.81 | 0.74 | 0.67 |
| | 13.8 | 1.59 | 1.50 | 1.41 | 1.32 | 1.24 | 1.16 | 1.08 | 1.00 | 0.93 | 0.85 | 0.78 | 0.71 |
| | 34.5 | 1.64 | 1.55 | 1.46 | 1.37 | 1.29 | 1.21 | 1.13 | 1.05 | 0.97 | 0.90 | 0.83 | 0.76 |
| | 68.9 | 1.73 | 1.64 | 1.55 | 1.46 | 1.38 | 1.29 | 1.21 | 1.13 | 1.06 | 0.98 | 0.91 | 0.84 |
| | 103.5 | 1.80 | 1.71 | 1.61 | 1.53 | 1.44 | 1.34 | 1.28 | 1.19 | 1.12 | 1.04 | 0.97 | 0.90 |
| | 137.9 | 1.86 | 1.77 | 1.68 | 1.58 | 1.50 | 1.42 | 1.33 | 1.25 | 1.17 | 1.10 | 1.02 | 0.95 |
| | 344.9 | 2.13 | 2.04 | 1.94 | 1.85 | 1.76 | 1.67 | 1.58 | 1.50 | 1.42 | 1.34 | 1.26 | 1.19 |
| | 517.3 | 2.28 | 2.18 | 2.09 | 1.99 | 1.90 | 1.81 | 1.72 | 1.64 | 1.55 | 1.47 | 1.40 | 1.32 |
| | 689.7 | 2.41 | 2.31 | 2.20 | 2.11 | 2.02 | 1.93 | 1.84 | 1.75 | 1.66 | 1.58 | 1.50 | 1.48 |
| | 862.2 | 2.51 | 2.41 | 2.31 | 2.21 | 2.11 | 2.02 | 1.93 | 1.84 | 1.76 | 1.68 | 1.59 | 1.51 |
| | 1034.6 | 2.60 | 2.50 | 2.40 | 2.30 | 2.20 | 2.11 | 2.02 | 1.93 | 1.84 | 1.76 | 1.67 | 1.59 |
| ENTERING WATER TEMP ° C | 71.1 |  | | | | 0.96 | 0.88 | 0.80 | 0.73 | 0.65 | 0.57 | 0.48 | 0.42 |
| | 76.7 | | | | | 1.04 | 0.95 | 0.87 | 0.77 | 0.71 | 0.63 | 0.55 | 0.47 |
| | 82.2 | | | | | 1.11 | 1.03 | 0.94 | 0.86 | 0.78 | 0.70 | 0.62 | 0.55 |
| | 87.8 | | | | | 1.19 | 1.10 | 1.01 | 0.93 | 0.85 | 0.77 | 0.69 | 0.61 |
| | 93.2 | | | | | 1.25 | 1.17 | 1.09 | 1.00 | 0.92 | 0.84 | 0.76 | 0.68 |
| | 98.9 | | | | | 1.33 | 1.24 | 1.16 | 1.07 | 0.99 | 0.91 | 0.83 | 0.75 |
| | 104.4 | | | | | 1.41 | 1.32 | 1.23 | 1.14 | 1.06 | 0.98 | 0.89 | 0.82 |
| | 110.0 | | | | | 1.48 | 1.39 | 1.30 | 1.21 | 1.13 | 1.05 | 0.97 | 0.89 |
| | 115.6 | | | | | 1.56 | 1.46 | 1.37 | 1.28 | 1.20 | 1.12 | 1.03 | 0.95 |
| | 121.1 | | | | | 1.63 | 1.54 | 1.45 | 1.36 | 1.27 | 1.18 | 1.10 | 1.02 |

## MODEL V VERTICAL DISCHARGE ( DRAW THROUGH ) UNITS

| | | ENTERING AIR TEMPERATURE ° C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -23 | -18 | -12 | -7 | -1 | 4 | 10 | 16 | 21 | 27 | 32 | 38 |
| STEAM PRESSURE kPa | 0 | 1.49 | 1.41 | 1.33 | 1.25 | 1.18 | 1.11 | 1.03 | 0.96 | 0.89 | 0.82 | 0.75 | 0.69 |
| | 13.8 | 1.52 | 1.44 | 1.37 | 1.29 | 1.22 | 1.14 | 1.07 | 1.00 | 0.93 | 0.86 | 0.79 | 0.73 |
| | 34.5 | 1.57 | 1.49 | 1.41 | 1.33 | 1.26 | 1.19 | 1.11 | 1.05 | 0.98 | 0.91 | 0.84 | 0.77 |
| | 68.9 | 1.64 | 1.56 | 1.48 | 1.40 | 1.33 | 1.25 | 1.18 | 1.11 | 1.04 | 0.97 | 0.93 | 0.84 |
| | 103.5 | 1.69 | 1.61 | 1.53 | 1.46 | 1.38 | 1.31 | 1.24 | 1.17 | 1.10 | 1.03 | 0.96 | 0.90 |
| | 137.9 | 1.73 | 1.65 | 1.57 | 1.50 | 1.42 | 1.35 | 1.28 | 1.21 | 1.13 | 1.07 | 1.00 | 0.94 |
| | 344.9 | 1.93 | 1.85 | 1.77 | 1.70 | 1.63 | 1.55 | 1.48 | 1.42 | 1.35 | 1.28 | 1.21 | 1.15 |
| | 517.3 | 2.04 | 1.97 | 1.90 | 1.82 | 1.75 | 1.68 | 1.61 | 1.54 | 1.47 | 1.40 | 1.33 | 1.27 |
| | 689.7 | 2.15 | 2.07 | 1.99 | 1.92 | 1.85 | 1.77 | 1.70 | 1.63 | 1.56 | 1.49 | 1.43 | 1.36 |
| | 862.2 | 2.21 | 2.14 | 2.06 | 1.99 | 1.91 | 1.84 | 1.77 | 1.70 | 1.63 | 1.56 | 1.49 | 1.43 |
| | 1034.6 | 2.28 | 2.20 | 2.13 | 2.05 | 1.98 | 1.91 | 1.84 | 1.77 | 1.70 | 1.63 | 1.56 | 1.50 |
| ENTERING WATER TEMP ° C | 71.1 |  | | | | 0.95 | 0.87 | 0.78 | 0.72 | 0.65 | 0.58 | 0.51 | 0.44 |
| | 76.7 | | | | | 1.02 | 0.84 | 0.86 | 0.77 | 0.71 | 0.64 | 0.57 | 0.50 |
| | 82.2 | | | | | 1.09 | 1.01 | 0.94 | 0.83 | 0.77 | 0.70 | 0.63 | 0.56 |
| | 87.8 | | | | | 1.16 | 1.08 | 1.01 | 0.92 | 0.84 | 0.77 | 0.70 | 0.63 |
| | 93.2 | | | | | 1.24 | 1.15 | 1.09 | 1.00 | 0.92 | 0.85 | 0.77 | 0.70 |
| | 98.9 | | | | | 1.32 | 1.23 | 1.16 | 1.09 | 0.99 | 0.91 | 0.85 | 0.77 |
| | 104.4 | | | | | 1.40 | 1.30 | 1.24 | 1.19 | 1.07 | 0.99 | 0.92 | 0.85 |
| | 110.0 | | | | | 1.47 | 1.38 | 1.31 | 1.25 | 1.14 | 1.06 | 0.98 | 0.92 |
| | 115.6 | | | | | 1.53 | 1.45 | 1.37 | 1.36 | 1.21 | 1.14 | 1.07 | 1.00 |
| | 121.1 | | | | | 1.63 | 1.55 | 1.48 | 1.43 | 1.31 | 1.22 | 1.17 | 1.10 |

## ACME ENGINEERING & MANUFACTURING CORP.

P.O. Box 978
MUSKOGEE, OKLAHOMA 74401

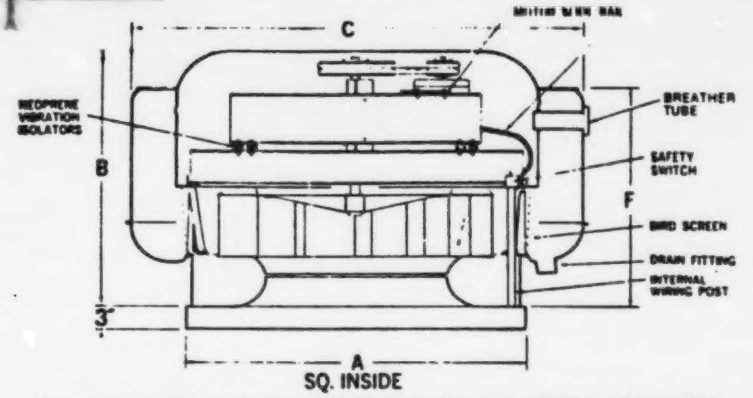
# CENTRIMASTER® UPBLAST ROOF EXHAUSTERS

## MODEL PRU, PU & PUH

## Direct & Belt Driven

| | |
|---|---|
| Project | MAINTENANCE BUILDING |
| Location | DEVON CAOL RESEARCH |
| Architect | |
| Engineer | KILBORN |
| Contractor | GEN-AIR VENTILATION |
| Submitted by | ENER-TECH INDUSTRIES ALBERTA LTD. |
| Date | NOVEMBER 16, 1987 |

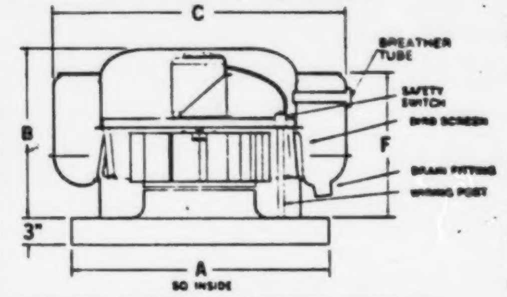
Dimensions given on this sheet are correct within limits suitable for normal installation requirements.


C
MOTOR SLIDE BASE
NEOPRENE VIBRATION ISOLATORS
B
BREATHER TUBE
SAFETY SWITCH
F
BIRD SCREEN
DRAIN FITTING
INTERNAL WIRING POST
3"
A
SQ. INSIDE

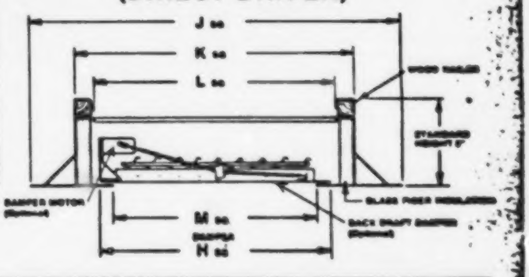
## MODELS PUH & PU135 THRU PU543 (BELT DRIVEN)

| Model | A | B | C | F | H | J | K• | L• | M |
|---|---|---|---|---|---|---|---|---|---|
| PRU135, 145 | 24" | 21¾" | 31½" | 16⅝" | 18" | 30½" | 22½" | 19½" | 16½" |
| PRU163, 171 | 28" | 24⅜" | 36" | 20¾" | 22" | 34½" | 26½" | 23½" | 20½" |
| PU135, 145 | 24" | 21¾" | 31½" | 16⅝" | 18" | 30½" | 22½" | 19½" | 16½" |
| PU163, 171 | 28" | 24⅜" | 36" | 20¾" | 22" | 34½" | 26½" | 23½" | 20½" |
| PU200 | 28" | 22½" | 36½" | 17" | 22" | 34½" | 26½" | 23½" | 20½" |
| PUH200 | 28" | 27¼" | 36½" | 21¾" | 22" | 34½" | 26½" | 23½" | 20½" |
| PU223 | 28" | 23⅛" | 36½" | 17⅝" | 22" | 34½" | 26½" | 23½" | 20½" |
| PU245 | 34" | 26½" | 42½" | 20¼" | 28" | 40½" | 32½" | 29½" | 26½" |
| PUH245 | 34" | 28⅜" | 42½" | 23¼" | 28" | 40½" | 32½" | 29½" | 26½" |
| PU270 | 34" | 27⅛" | 42½" | 20⅛" | 28" | 40½" | 32½" | 29½" | 26½" |
| PU300 | 40" | 29¾" | 54" | 24¼" | 34" | 46½" | 38½" | 35½" | 32½" |
| PUH300 | 40" | 31¾" | 54" | 26¾" | 34" | 46½" | 38½" | 35½" | 32½" |
| PU330 | 40" | 30½" | 54" | 25⅝" | 34" | 46½" | 38½" | 35½" | 32½" |
| PU365 | 46" | 33¼" | 65" | 28¼" | 40" | 52½" | 44½" | 41½" | 38½" |
| PUH365 | 46" | 36" | 65" | 30¼" | 40" | 52½" | 44½" | 41½" | 38½" |
| PU403 | 46" | 34¼" | 65" | 29¼" | 40" | 52½" | 44½" | 41½" | 38½" |
| PU490 | 60" | 41⅜" | 79" | 32½" | 54" | 66½" | 58½" | 55½" | 52½" |
| PU543 | 60" | 43⅛" | 79" | 34¼" | 54" | 66½" | 58½" | 55½" | 52½" |

• Dimensions shown are for RF curb, for SF add 1" to "K" & "L" dimensions


C
BREATHER TUBE
SAFETY SWITCH
BIRD SCREEN
B
F
DRAIN FITTING
WIRING POST
3"
A
SQ INSIDE

## MODELS PRU135 THRU PRU 171 (DIRECT DRIVEN)


J sq
K sq
L sq
WOOD NAILER
STANDARD HEIGHT 8"
DAMPER MOTOR (Optional)
GLASS FIBER INSULATION
M sq
DAMPER
H sq
BACK DRAFT DAMPER (Optional)

## FEATURES

- Exhausted air discharged high above roof.
- Integral grease trough with built in drain fitting.
- Windband removable for inspection and cleaning.
- Hollow airfoil blades for quieter performance.
- Backward curved non-overloading impeller, statically and dynamically balanced.
- Aluminum housing, base and impeller with gauges from .050 to .125.
- Motors out of air stream.
- Forced air cooling system for motors provides a continuous supply of clean outside air thru breather tubes.
- Cast iron adjustable pulleys; motors mounted on rails for quick speed change.
- Pre-lubricated ball bearings on fan and motor.
- Drives are 1 or 2 belt combinations depending on horsepower.

**WARNING!** DO NOT use in HAZARDOUS ENVIRONMENTS where fans electrical system could provide ignition to combustible flammable materials, unless unit is specifically built for hazardous environments.

**CAUTION!** Guards must be installed when fan is within reach of personnel or within seven (7) feet of working level or when deemed advisable for safety.

O - Open (Dripproof)
EX - Explosion Proof
2S - Two Speed
AR - Automatic Damper
MT - Motorized Damper
HS - Heat Shield
EWB - Extended Windband

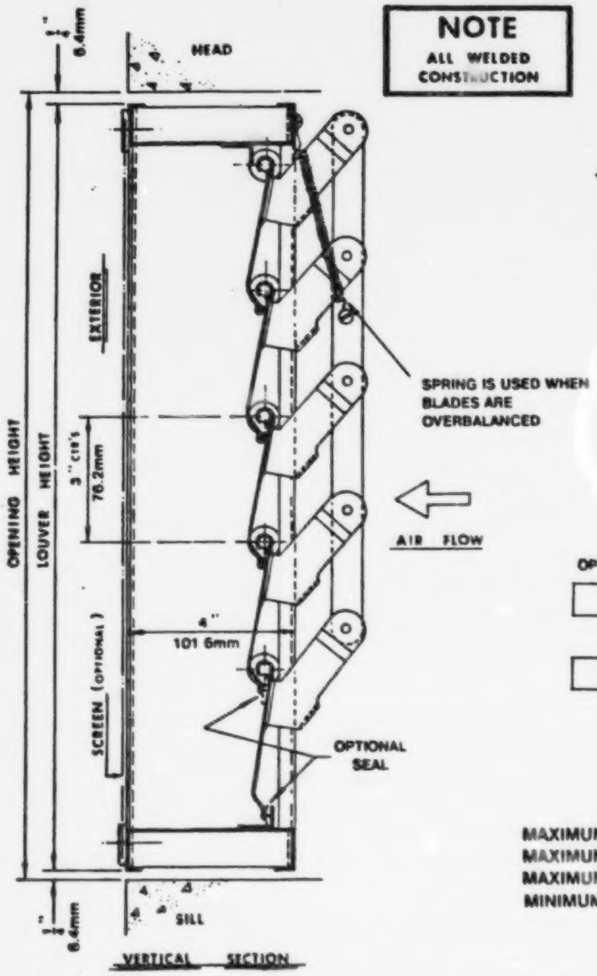
Litho in USA

| SPECIFICATIONS | | FAN | | | | | MOTOR | | | OPTIONAL ACCESSORIES |
|---|---|---|---|---|---|---|---|---|---|---|
| Reference | Quan | Model | CFM | SP | RPM | Sound Rating* | HP | Current | Type | |
| EF-1 & 2 | 2 ✓ | PU-300H ✓ | 2340L/S ✓ | 36pa ✓ | 460 | 9.0 | .56 kw ✓ | 575/60/3 ✓ | EX ✓ | BDD & DS<br>MODEL RF PREFAB ROOF CURB |

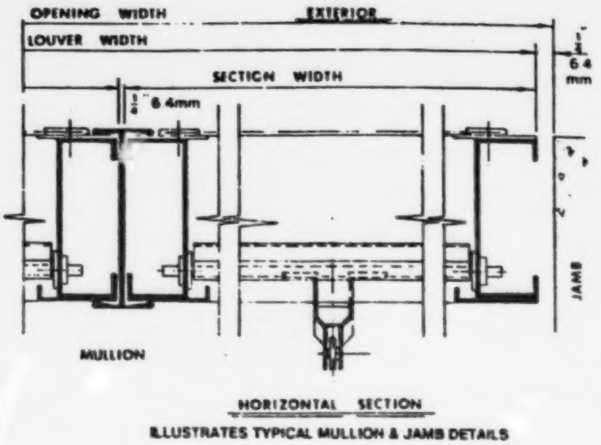
* Certified Sound Ratings in decibels for each of 8 octave bands in Lw(A) decibels and in sones are shown in Acme Bulletin S31.

Submittal Sheet No. 31H-1

**NOTE**
ALL WELDED CONSTRUCTION


6.4mm
HEAD
OPENING HEIGHT
LOUVER HEIGHT
EXTERIOR
3" CTR'S
76.2mm
4"
101.6mm
SCREEN (OPTIONAL)
SPRING IS USED WHEN BLADES ARE OVERBALANCED
AIR FLOW
OPTIONAL SEAL
SILL
6.4mm

VERTICAL SECTION


OPENING WIDTH
EXTERIOR
LOUVER WIDTH
SECTION WIDTH
6.4mm
6.4 mm
MULLION
JAMB

HORIZONTAL SECTION
ILLUSTRATES TYPICAL MULLION & JAMB DETAILS

OPTIONAL SEAL
☐ FELT STRIP
☐ NEOPRENE SPONGE

OPERATION
☐ INLET TYPE
☐ OUTLET TYPE

MAXIMUM SECTION WIDTH-48" (1219.2mm)
MAXIMUM SECTION HEIGHT-72" (1829.0mm)
MAXIMUM 24 SQ. FT. IN ONE SECTION (2.3 sq.m.)
MINIMUM SIZE 9" X 9" (228.6mm. X 228.6mm.)

NOTE. ALL METRIC DIMENSIONS ARE SOFT CONVERSION. IMPERIAL DIMENSIONS ARE CONVERTED TO METRIC AND ROUNDED TO THE NEAREST TENTH OF A MILLIMETER

**MATERIAL:** 16 GA. EXTR. ALUM. BLADES & 14 GA. FORMED ALUM. FRAMES

**FINISH:** MILL -

| ITEM | QUAN. | LOUVER SIZE WIDTH × HEIGHT | SECT. QUAN. | SECTION SIZE WIDTH × HEIGHT | OPENING SIZE WIDTH × HEIGHT |
|---|---|---|---|---|---|
| 1 | 1 | 11½ x 11½ |  |  | 12 x 12 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

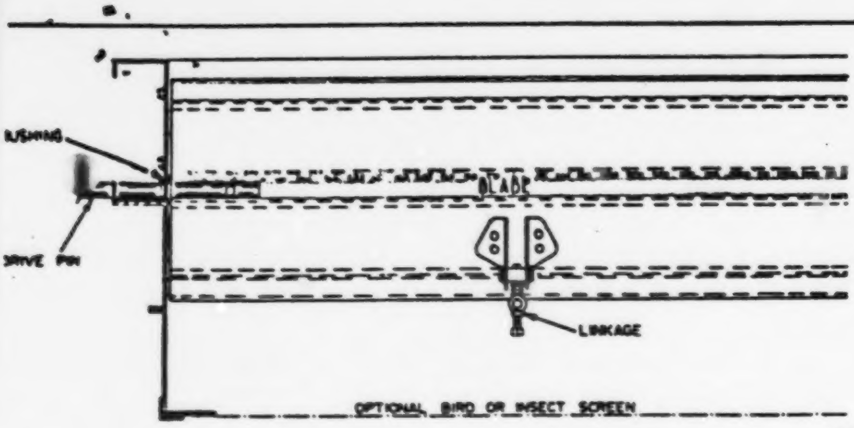
**METHOD OF INSTALLATION**
CHANNEL
As SHOWN

**SCREEN MATERIAL & TYPE**

**SCREEN LOCATION**
DOWNSTREAM ONLY

**PROJECT:** DEVON COAL RESEARCH FIELD MAINT. BLDG
**CUSTOMER:** GEN AIR
**ARCHITECT:**
**ENGINEER:** KILBORN

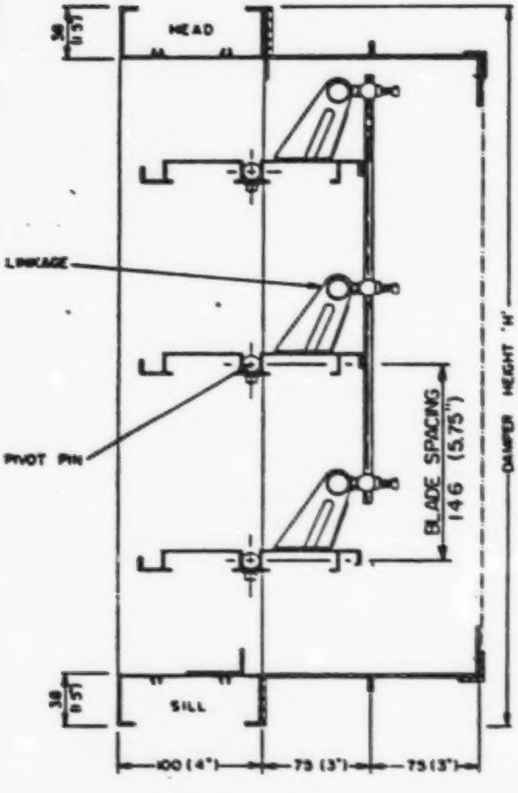
| | | | |
|---|---|---|---|
| FEB.1979 | e.h.price LIMITED | 725 | AIROLITE TYPE 725 GRAVITY LOUVER |


BUSHING
BLADE
DRIVE PIN
LINKAGE
OPTIONAL BIRD OR INSECT SCREEN

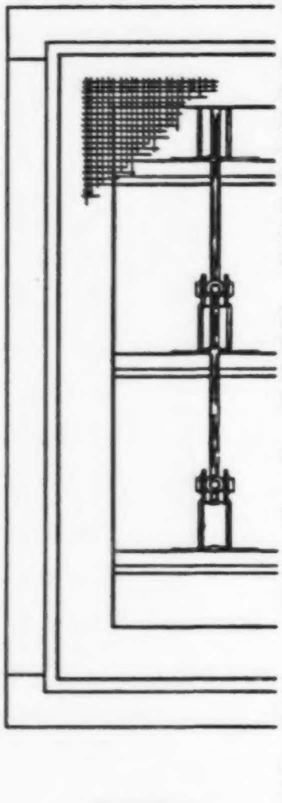
HORIZONTAL SECTION

westvent®

# MODEL PBX-4C6
# PARALLEL BLADE DAMPER


38 (1.5")
HEAD
LINKAGE
PIVOT PIN
BLADE SPACING 146 (5.75")
DAMPER HEIGHT 'H'
38 (1.5")
SILL
100 (4")
75 (3")
75 (3")

VERTICAL SECTION



ELEVATION

**STANDARD SPECIFICATIONS**

CONST. - Extruded Alum. Frame, Screwed Assembly, Butt Corners, Gussets, Mullions & Spreader Bars On All Sections 60"(1500) And Larger
FRAME - 4"(101.6) x 1.5"(38.1) x .081"(2.06) Extruded Aluminum Channel, Butt Corners
BLADES - 6"(152.4) x .63"(16) x .081"(2.06) Extruded Alum.
SEALS - Optional
SHAFTS - .50"(12.7) Diameter Plated CR Steel
BEARINGS - .50"(12.7) Oilite Bronze Bushings
DRIVE SHAFT - .50"(12.7) Diameter x 10"(254) Plated Cold Rolled Steel
LINKAGE - In Airstream
FINISH - Mill Aluminum
SECTION - Maximum 60"(1500) x 96"(2400)

**OPTIONS**

FRAME - Welded Assembly
BLADES - Same As Standard Specifications (Above)
BEARINGS - .50"(12.7) Nylon Bushings
.50"(12.7) Ball Bearings
SEALS - Santaprene Blade Tip, Stainless Steel Side Seals
SCREEN - Additional Frame c/w 88 Galvanized or Fibreglass Bug Screen
FINISH - Anodized
CONTROL - Hand Quadrants, Actuators, Jack Shafts, & Brackets

**TECHNICAL NOTES:**

MAXIMUM Recommended Velocity - 2000 F.P.M.
- With Airfoil Plate - 3000 F.P.M.
MAXIMUM TEMPERATURE - 250 Degrees Farenheit
SHIPPING WEIGHT - Approximately 6 Lbs./Sq. Ft.
*FOR MORE INFORMATION, CONTACT OUR FACTORY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 600mm x 600mm | | | | | | |

## VOLUME CONTROL DAMPER

WESTERN VENTILATION PRODUCTS LTD.

MAR 18'82

ENER-TECH INDUSTRIES ALBERTA LTD

GEN-AIR VENTILATION

KILBORN

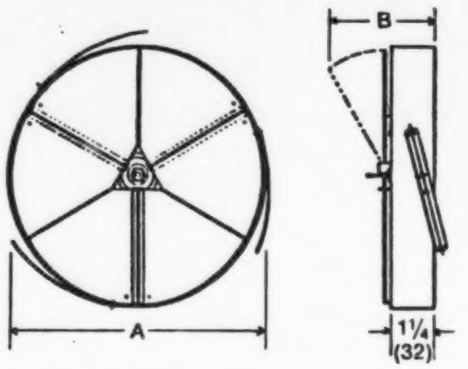
MAINTENANCE BUILDING - DEVON

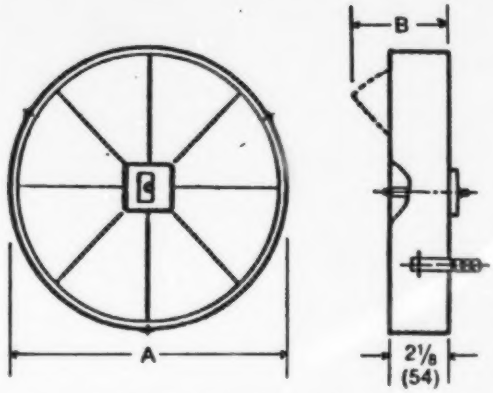
NOV 16/87

e.h.price LIMITED

# Submittal Sheet

## VCR 7 RADIAL OPPOSED BLADE DAMPER





**VCR 7 sizes 6 through 12**
Material: .032 Wiped coat steel.
Finish: Mill Finish.

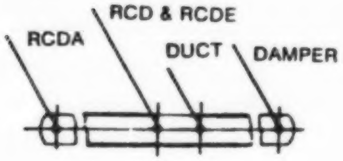
**VCR 7 sizes 14 through 36**
Optional operator rod may be fastened to damper from either side.
Material: .035 Steel.
Finish: B17 Black.

**S.I. UNITS**

| Size | A | B |
|---|---|---|
| 6 | 149 | 114 |
| 7 | 175 | 127 |
| 8 | 200 | 139 |
| 10 | 251 | 164 |
| 12 | 302 | 191 |
| 14 | 352 | 124 |
| 15 | 378 | 130 |
| 16 | 403 | 143 |
| 18 | 454 | 159 |
| 20 | 505 | 178 |
| 24 | 606 | 171 |
| 30 | 759 | 210 |
| 36 | 911 | 248 |

**IMPERIAL UNITS**

| Size | A | B |
|---|---|---|
| 6 | 5⅞ | 4½ |
| 7 | 6⅞ | 5 |
| 8 | 7⅞ | 5½ |
| 10 | 9⅞ | 6½ |
| 12 | 11⅞ | 7½ |
| 14 | 13⅞ | 4⅞ |
| 15 | 14⅞ | 5⅛ |
| 16 | 15⅞ | 5⅝ |
| 18 | 17⅞ | 6¼ |
| 20 | 19⅞ | 7 |
| 24 | 23⅞ | 6¾ |
| 30 | 29⅞ | 8¼ |
| 36 | 35⅞ | 9¾ |



1) VCR 7 RADIAL OPPOSED BLADE — VOLUME CONTROL DAMPER w/SLEEVE — FOR DUCT MOUNTED INSTALLATION.
2) FOR MINIMUM HEIGHT, MOUNT DAMPER DIRECTLY TO DIFFUSER USING CORRECT HOLE.

ALL METRIC DIMENSIONS ( ) ARE SOFT CONVERSION. IMPERIAL DIMENSIONS ARE CONVERTED TO METRIC AND ROUNDED TO THE NEAREST MILLIMETER

**PROJECT:** DEVON COAL RESEARCH FIELD MAINT. BLDG
**ENGINEER:** KILBORN
**CUSTOMER:** GEN AIR
**SUBMITTAL DATE:**
**SPEC. SYMBOL:** S 2 & 3

e.h.price LIMITED
205954
OCT/86

**VCR 7**
RADIAL OPPOSED BLADE DAMPER

©Copyright E.H. PRICE LIMITED 1986

Printed in Canada

# CURTAIN TYPE FIRE DAMPERS
HORIZONTAL AND VERTICAL
1½ HOURS*

### STANDARD CONSTRUCTION

**Frame:**
Roll Formed Galvanized Steel with Safety Edge.

**Blades:**
Roll Formed Galvanized Steel, Curtain-Type.

**Springs:**
Stainless Steel.

**Fusible Link:**
U.L. Listed 165° Standard (Other Temperatures Available).

**Enclosure:**
18 ga. Galvanized Steel.

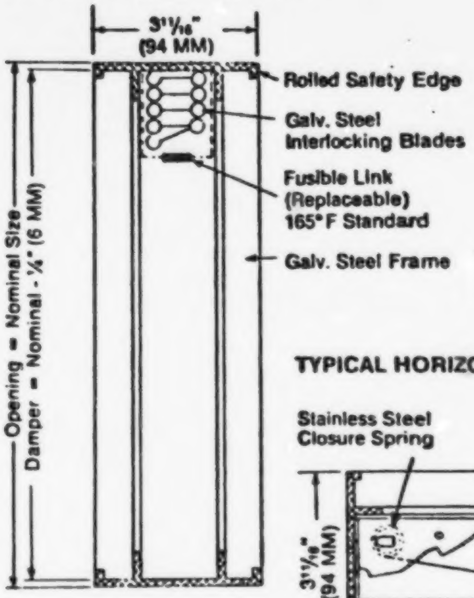
**Transition Collars:**
22 ga. Galvanized Steel.

**Option:**
Stainless Steel Construction.

**Mounting:**
Horizontal or Vertical.

**Finish:**
Mill Galvanized Standard.

### TYPICAL VERTICAL DAMPER

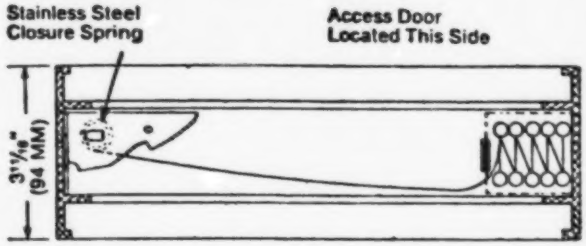

3$^{11}/_{16}$"
(94 MM)
Rolled Safety Edge
Galv. Steel Interlocking Blades
Fusible Link (Replaceable) 165°F Standard
Galv. Steel Frame
Opening = Nominal Size
Damper = Nominal - ¼" (6 MM)

### LISTED AND LABELLED BY:

UL ULC

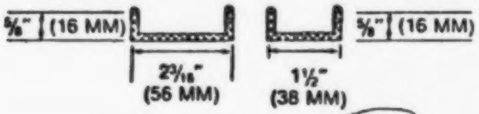
1½ HOUR RATING
*For use in fire barriers rated for 2 hours or less.

### TYPICAL HORIZONTAL DAMPER

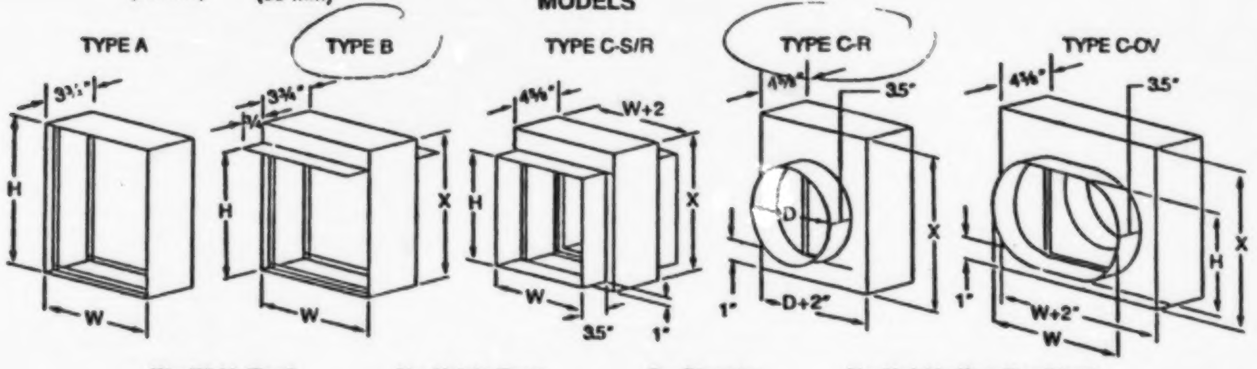

Stainless Steel Closure Spring
Access Door Located This Side
3$^{11}/_{16}$"
(94 MM)

Patent Applied For

### OPTION:
NARROW FRAME


⅝" (16 MM)
2$^{3}/_{16}$"
(56 MM)
1½"
(38 MM)
⅝" (16 MM)

### MODELS


TYPE A
[✓ TYPE B]
TYPE C-S/R
[✓ TYPE C-R]
TYPE C-OV
3½"
3¾"
¼
4⅜"
4⅜"
4⅜"
W+2
3.5"
3.5"
3.5"
1"
1"
1"
H
X
D
D+2"
W+2"
W

W = Width (Duct) H = Height (Duct) D = Diameter X = Variable (See Size Chart)

ALL DAMPERS MADE BY MEMBERS OF S.M.W.I.A. LOCAL #30

Project: DEVON COAL RESEARCH
Location: FIELD MAINT. BLDG
Architect:
Engineer: KILBORN

Contractor: GEN AIR
Address:
P.O. Number:
Date:

Copyright CAML/NCA 1986

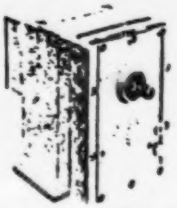
Controlled Air Manufacturing Limited • MISSISSAUGA-ONTARIO • National Controlled Air, Inc. • DALLAS-TEXAS

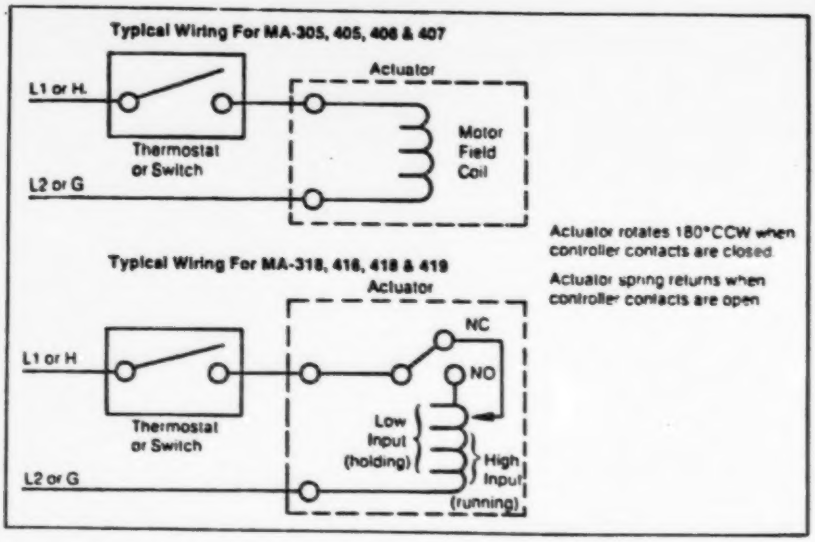
JECT: MAINTENANCE BLDG.
NTRACTOR: GEN-AIR VENTILATION
GINEER: KILBORN
PLIER: ENER-TECH IND.
IPMENT: 1 - M405 XP motor
for 600x600 mm damper

ENER-TECH INDUSTRIES ALBERTA LTD.
EDMONTON CALGARY

# ACTUATORS
# TWO-POSITION, SPRING RETURN

**MA-305**
**MA-318**
**MA-405**
**MA-406**
**MA-407**
**MA-416**
**MA-418**
**MA-419**





Actuator rotates 180°CCW when controller contacts are closed.

Actuator spring returns when controller contacts are open.

**For two-position operation of dampers, valves and other equipment which require the return to normal position upon power interruption.**

Two-wire circuit. Actuator shaft rotates CW 180° when power is applied. Spring returns actuator shaft CCW to original position when actuator is de-energized. Optional SPDT auxiliary end switch makes (or breaks) circuit at powered end of stroke. Ambient temperature limitations -40 to 136°F. 16 lb-in. actuators mounted in any position; 60 lb-in. must be mounted with output shaft horizontal. Allow 6" clearance above the actuator wiring compartment. **Dimensions:** 5-3/4" (146 mm) high × 5-3/8" (136 mm) wide × 6-9/16" (167 mm) deep

**OPTIONS:** Available 120, 208, 240 Vac; 50 or 60 Hz. 50 Hz specify MA5-3XX, MA5-4XX. For hazardous locations specify MA6-3XX, MA6-4XX (60 Hz) or MA7-3XX, MA7-4XX (50 Hz); actuators factory assembled in AM-401, UL listed and CSA certified.

**ACCESSORIES:**

Damper linkage accessories:

| | |
|---|---|
| AM-111 | Crank arm for 5/16" diameter damper shaft |
| AM-112 | Crank arm for 3/8" diameter damper shaft |
| AM-113 | Crank arm for actuator or 1/2" diameter damper shaft |
| AM-115 | Crank arm for 7/16" diameter damper shaft |
| AM-116 | Splined crank arm for actuator |
| AM-122 | Linkage connector straight type |
| AM-123 | Damper clip |
| AM-125 | 5/16" diameter × 20" damper rod |
| AM-125-048 | 5/16" diameter × 48" damper rod |
| AM-132 | Ball joint connector |
| AM-161 | Damper linkage kit |
| AM-161-1 | Damper linkage kit |
| AM-301 | 90 degree mounting bracket |
| AM-401 | Housing for hazardous locations |

Valve linkage accessories for 60 lb-in. units only. Use on VB-202, VB-212, VB-804 and VB-817 valve bodies, 1/2" to 2".

| | |
|---|---|
| *AV-21 | Cam and plunger kit for VB-202, VB-212, VB-804, 1/2" to 2" valves |
| *AV-29 | Cam and plunger kit for VB-817, 1/2" to 2" valves |
| *AV-300 | Common parts linkage kit |

*Order AV-300 plus appropriate AV-21 or AV-29 for complete linkage

Valve linkage accessories for 60 lb-in. units only. Use on VB-92X3 or VB-93X3 valve bodies, 1/2" to 2".

| | |
|---|---|
| AV-391 | Valve linkage for 1/2" to 1-1/4" VB-92X3 or VB-93X3 |
| AV-392 | Valve linkage for 1-1/2" & 2" VB-92X3 or 93X3 |

| Actuator Part Number | Supply Voltage (Vac) 60 Hz | Aux. End Switch | Inputs (Watts) | Rated Torque Lb.-In. | No Load Timing † at 75°F Secs/180° | Nominal Damper Area ** Sq-Ft. | | Applications | VA* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Parallel | Opposed | | |
| MA-305 | 24 | No | 25 | 16 | 20 | 9 | 11 | Damper | 45 |
| MA-305-500 | 24 | Yes | | | | | | | |
| MA-405 | 120 | No | | | | | | | |
| MA-405-500 | 120 | Yes | | | | | | | |
| MA-406 | 208 | No | | | | | | | |
| MA-406-500 | 208 | Yes | | | | | | | |
| MA-407 | 240 | No | | | | | | | |
| MA-407-500 | 240 | Yes | | | | | | | |
| MA-318 | 24 | No | 70 Running<br>25 Holding | 60 | 20 | 33 | 43 | Valve or Damper | 85 Running<br>45 Holding |
| MA-318-500 | 24 | Yes | | | | | | | |
| MA-418 | 120 | No | | | | | | | |
| MA-418-500 | 120 | Yes | | | | | | | |
| MA-416 | 208 | No | | | | | | | |
| MA-416-500 | 208 | Yes | | | | | | | |
| MA-419 | 240 | No | | | | | | | |
| MA-419-500 | 240 | Yes | | | | | | | |

*2 FLA, 12 LRA @ 24/120 Vac; 1 FLA, 6 LRA @ 240 Vac.

**Damper ratings are nominal and based on standard (not low leakage) dampers at 1" W.C. Pressure and 2000 FPM velocity

†Spring return timing with full load opposing spring approximately 60 seconds.

**WHITE-RODGERS**
The "TOTAL CONCEPT" People

– COMMERCIAL CONTROLS –

# TYPES 3405-2, 3405A-2, 3405-11, 3405A-11 LOW VOLTAGE (TWO POSITION – SPRING RETURN) LOW TORQUE MOTOR ACTUATOR

## Product Information

Type 3405 motor actuator is compact in size and features oil-immersed power unit and gear train. Suitable for use in ambients from −40 to +125°F. These motors are of the two-position spring return type and are for use with conventional 2-wire controller.

### FEATURES

- Heavy duty die cast zinc enclosure is weatherproof and dust-proof.
- Oil-immersed gear train assures quiet operation and long life.
- Low ambient operation (down to −40°F) is achieved without addition of heater.
- Double-ended shaft permits actuation from either or both ends of shaft.
- Motor operates from 40 VA Class II transformer with 24v secondary.
- Compact size permits versatility of mounting.
- Type 3405-10 has an adjustable switch (SPDT) for auxiliary equipment, burner interlock or cascading motor actuators.
- Models available with 24 volt and 120 volt input.
- Multi-poise mounting

### SPECIFICATIONS

**Type Motor**: Two position, spring return.

**Stroke**: 90° of crank rotation.

**Torque**: 20 in. lb. (either end, or divided between ends).

**Timing**: Approx. ½ minute.

**Ambient Rating**: −40° to +125°F.

**Motor Electrical Rating:**
Input – 24v, 60 Hz., 1.1 Amps.
– 120v, 60 Hz., .25 Amps.

**Crankshaft**: 3/8" round, double-ended.

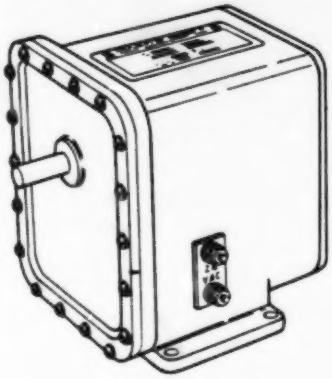
**Direction of Shaft Rotation**: Counter clockwise when power is applied (viewing shaft from end with large end plate).

**Controller**: 2-wire (SPST).

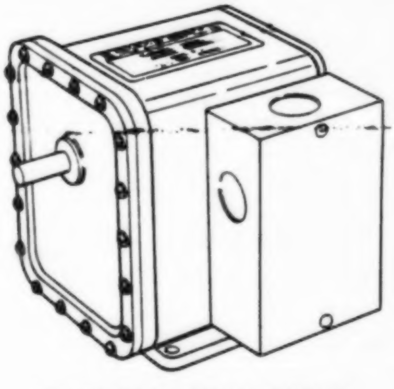
**Auxiliary Switch:**
**SPDT** – adjustable
**Leads** – red, yellow and blue
**Ratings** –
8FLA, 48LRA @ 120v 60 Hz.
4FLA, 24LRA @ 240V 60 Hz.
Pilot duty 40VA @ 24,120,240V 60 Hz.

**Weight**: Approx. 7 lbs.

**Mounting Position**: Mounts to vertical, horizontal, or sloping surface, (Vertical shaft develops 90% of rated torque with flange up and 80% of rated torque with flange down).



TYPE 3405-2



TYPES 3405A-2, 3405-11, 3405A-11

**TYPES AVAILABLE**

| Type No. | Input Voltage | Auxiliary Switch | Junction Box |
|---|---|---|---|
| 3405-2 | 24v 60 Hz. | – | – |
| 3405-11 | 24v 60 Hz. | Yes | Yes |
| 3405A-2 | 120v 60 Hz. | No | Yes |
| 3405A-11 | 120v 60 Hz. | Yes | Yes |

### ACCESSORIES
(to be Ordered Separately)

**S81-125 Transformer**: Plate-mounted, 120v Pri., 25v Sec., (40VA).

**S81-130 Transformer**: Plate-mounted, 240v Pri., 25v Sec., (40VA).

**Motor Crankarms, Ball Joints and Push Rods**: See accessories sheet No. 37-2603.

WHITE-RODGERS DIVISION
EMERSON ELECTRIC CO
9797 REAVIS ROAD
ST. LOUIS, MISSOURI 63123
EMERSON®

Printed in U.S.A.

**PART No. 37-2621-1**
Replaces 37-2621

## DIMENSIONS

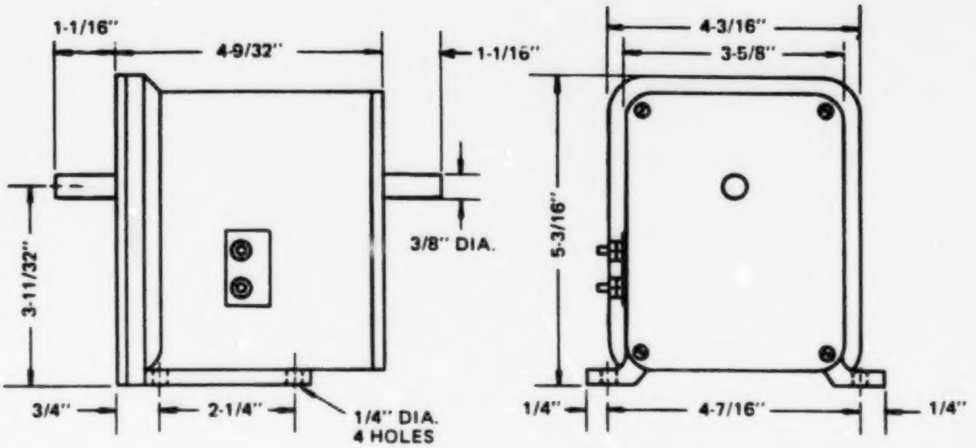
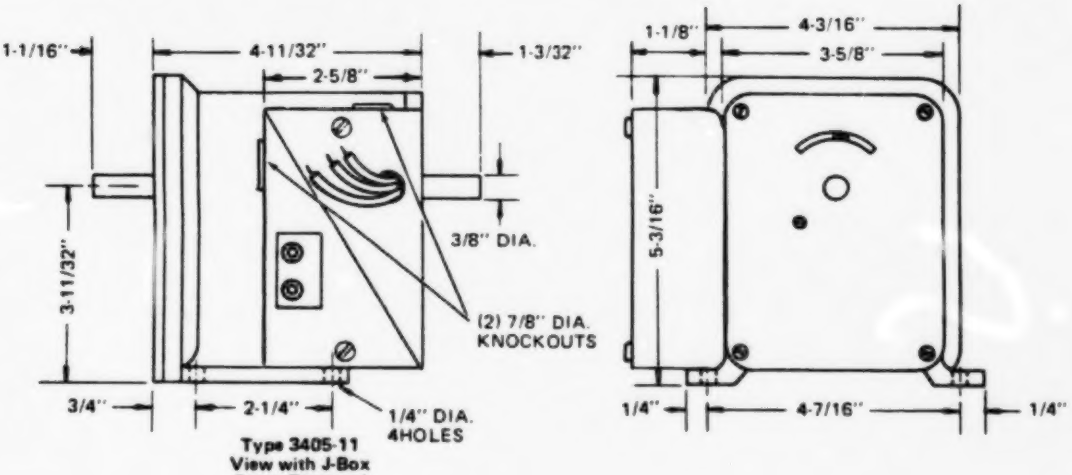

1-1/16"
4-9/32"
1-1/16"
3/8" DIA.
3-11/32"
3/4"
2-1/4"
1/4" DIA.
4 HOLES
4-3/16"
3-5/8"
5-3/16"
1/4"
4-7/16"
1/4"

Fig. 1 – Dimensions for Type 3405-2


1-1/16"
4-11/32"
1-3/32"
2-5/8"
3/8" DIA.
3-11/32"
(2) 7/8" DIA.
KNOCKOUTS
3/4"
2-1/4"
1/4" DIA.
4HOLES
1-1/8"
4-3/16"
3-5/8"
5-3/16"
1/4"
4-7/16"
1/4"

Type 3405-11
View with J-Box
Cover Removed

Fig. 2 – Dimensions for Type 3405-11, 3405A-2, 3405A-11

## WIRING

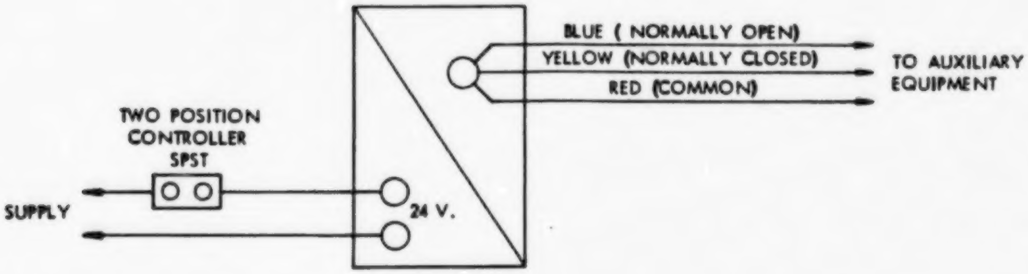

BLUE ( NORMALLY OPEN)
YELLOW (NORMALLY CLOSED)
RED (COMMON)
TO AUXILIARY
EQUIPMENT
TWO POSITION
CONTROLLER
SPST
SUPPLY
24 V.

Fig. 3 – Type 3405-11

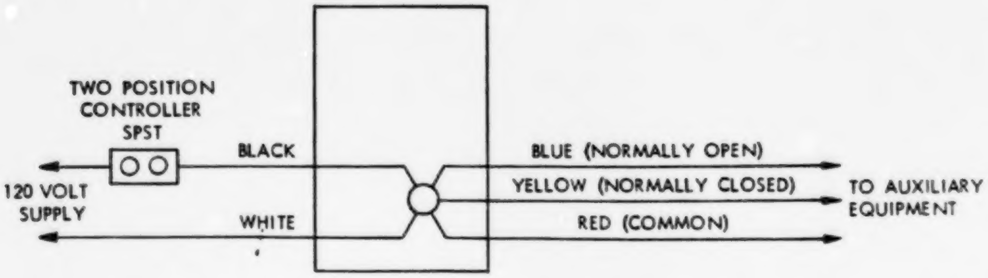

TWO POSITION
CONTROLLER
SPST
120 VOLT
SUPPLY
BLACK
WHITE
BLUE (NORMALLY OPEN)
YELLOW (NORMALLY CLOSED)
RED (COMMON)
TO AUXILIARY
EQUIPMENT

Fig. 4 – Type 3405A-11

## AUXILIARY SWITCH ADJUSTMENT

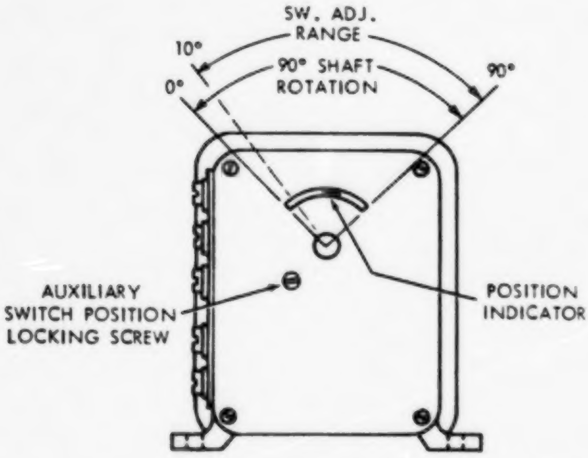

SW. ADJ.
RANGE
10°
0°
90° SHAFT
ROTATION
90°
AUXILIARY
SWITCH POSITION
LOCKING SCREW
POSITION
INDICATOR

Fig. 5 – Auxiliary Switch Position Adjustment

The internal SPDT auxiliary switch can be adjusted to operate between 10 and 90 degrees shaft rotation (See Fig. 4). The switch will close the R–B circuits (N.O. contacts) during the power stroke (shaft rotating counterclockwise, viewed from flange end).

To adjust switch proceed as follows:

–Loosen locking screw.

–Adjust position indicator to approximate midpoint of slot, tighten locking screw.

–Apply power to motor

–Note system function when switch operates.

–If motor has not rotated far enough when switch operates move indicator clockwise.

–If motor has rotated too far, move indicator counter-clockwise.

–Repeat power stroke and note system function.

–Re-adjust as necessary

–Tighten locking screw.

**Honeywell**

# PROPORTIONING TEMPERATURE CONTROLLERS

THE T991E,F PROPORTIONING TEMPERATURE CONTROLLERS WITH END SWITCH PROVIDE ON-OFF AND MODULATING CONTROL OF LIQUID OR AIR TEMPERATURES IN BOILERS, STORAGE TANKS, OR AIR DUCTS.

☐ T991F dual bulb model provides automatic reset of the control point as the outdoor air temperature changes.

☐ For use with series 90 (modulating) actuators or motors.

☐ Series 40, spst, line voltage end switch cycles burner off and on when low fire position exceeds firing requirements, or turns burner on prior to modulating control on temperature fall.

☐ Rugged, heavy-duty potentiometer assembly has increased resistance to vibration to allow use of T991 with V9055 Modulating Gas Valve Actuator.

☐ Liquid-filled, remote bulb, temperature sensing element (T991F element has 2 bulbs).

☐ Capillary tubing allows remote mounting of sensing element; available in various lengths as a special option.

☐ Sensing bulb can be directly immersed in a liquid or mounted in an immersion well for boiler or storage tank applications, or duct-mounted for warm air applications.

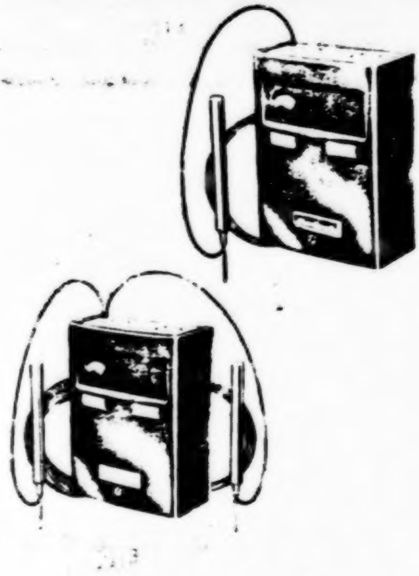
☐ T991F outdoor bulb can be mounted in an outdoor duct, or outdoors with a bulb shield.

☐ Mounting accessories are available for all applications.

☐ Set point adjusting screw on front of case.

☐ T991 can be mounted in any position.

**J.B.**
**REV. 7-78 (.12)**



## T991E,F

Form Number 60-2176-5

# SPECIFICATIONS

**IMPORTANT**

**THE SPECIFICATIONS GIVEN IN THIS PUBLICATION DO NOT INCLUDE NORMAL MANUFACTURING TOLERANCES. THEREFORE, THIS UNIT MAY NOT MATCH THE LISTED SPECIFICATIONS EXACTLY. ALSO, THIS PRODUCT IS TESTED AND CALIBRATED UNDER CLOSELY CONTROLLED CONDITIONS, AND SOME MINOR DIFFERENCES IN PERFORMANCE CAN BE EXPECTED IF THOSE CONDITIONS ARE CHANGED.**

MODELS:

T991E Proportioning Temperature Controller—provides on-off and modulating control of liquid or air temperatures in boilers, storage tanks, or air ducts. Includes end switch that can be used as a burner controller; cycles burner on and off *above* high temperature (low fire) end of proportioning range.

T991F Dual Bulb Proportioning Temperature Controller—same as T991E except with 2 sensing bulbs to provide automatic reset of the control point as the outdoor air temperature changes.

POTENTIOMETER: Single; 135 ohms resistance; wiper moves toward "W" end on temperature rise.

END SWITCH: Series 40, line voltage, spst (single-pole, single-throw), snap-acting. Operates *above* high temperature (low fire) end of proportioning range.

"Make" point on temperature fall—adjustable, 1 to 4 F [0.6 to 2.2 C] above high end of proportioning range (factory-set at 1 F [0.6 C] above proportioning range).

Breaks at "make" point *plus* differential on temperature rise.

Differential—4 F [2.2 C], fixed, additive.

ELECTRICAL RATINGS:

Proportioning Controller—low voltage (24V ac) series 90 only.

End Switch—

| VOLTAGE | FULL LOAD (amperes) | LOCKED ROTOR (amperes) |
|---|---|---|
| 120V ac | 2.6 | 15.6 |
| 240V ac | 1.3 | 7.8 |

2 amperes at 24V ac.

TEMPERATURE RANGE: See SCALE RANGE in Table I.

PROPORTIONING (THROTTLING) RANGE: 11 F [6 C], fixed. Set point is at *center* of proportioning range (see Fig. 13).

MAXIMUM AMBIENT OPERATING TEMPERATURE (CONTROLLER CASE): 125 F [52 C].

MAXIMUM SAFE BULB TEMPERATURE: See Table I.

MAXIMUM STORAGE TEMPERATURE (T991F only): 132 F [56 C].

TABLE I—TEMPERATURE RANGES

| MODEL | SCALE RANGE | | MAXIMUM SAFE BULB TEMPERATURE | |
|---|---|---|---|---|
| | FAHRENHEIT | CELSIUS | F | C |
| T991E1018[a] | 160 to 260[a] | 71 to 127 | 280 | 138 |
| T991E1026 | 0 to 100 | -18 to +38 | 125 | 52 |
| T991E1034 | 55 to 175 | 13 to 79 | 200 | 93 |
| T991F1009 | 70 to 140[b] | 21 to 60[b] | 265[c] | 129[c] |

[a] With mechanical stop, factory-set at 240 F [116 C].

[b] Indoor set point.

[c] Indoor bulb temperature plus outdoor bulb temperature must not exceed 265 F [129 C].

*(continued on page 3)*

# ORDERING INFORMATION

**WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—**

1. **Order number.**
2. **Temperature range (T991E only).**
3. **Accessories, if required.**
4. **Special options, if required.**

**IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:**

1. **YOUR LOCAL HONEYWELL RESIDENTIAL DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).**
2. **RESIDENTIAL DIVISION CUSTOMER SERVICE**
   **HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH**
   **MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500**

   **(IN CANADA—HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)**
   **INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.**

**RESET RATIO (T991F only):** 1:1 (ratio of change in outdoor air temperature to change in control point of the heating medium).

**TEMPERATURE SENSING ELEMENT:** Liquid-filled, remote bulb, copper (T991F has 2 bulbs).

**SENSING BULB SIZE:** Length – 4-3/16 inches [106.4 mm]; diameter – 1/2 inch [12.7 mm].

**MAXIMUM SENSING BULB PRESSURE:** 50 psi [344.7 kPa] for direct immersion.

**CAPILLARY MATERIAL:** Copper.

**CAPILLARY LENGTH:**
T991E–5 feet [1.5 metres].
T991F–indoor, 10 feet [3.0 metres]; outdoor, 30 feet [9.1 metres].

**WIRING KNOCKOUTS:** Four, 7/8-inch [22.2 mm] diameter knockouts for 1/2 inch conduit (2 in the top and 2 in the bottom).

**CONTROLLER MOUNTING:** Three slotted holes in back of case (see Fig. 1).

**SENSING BULB MOUNTING:**
In boilers or storage tanks–immersion well (Fig. 2) or capillary compression fitting (Fig. 3).
In air ducts–capillary holder (Figs. 4-6).
Outdoor bulb (T991F only)–bulb shield (Figs. 7-8).

**DIMENSIONS:** See Fig. 1.

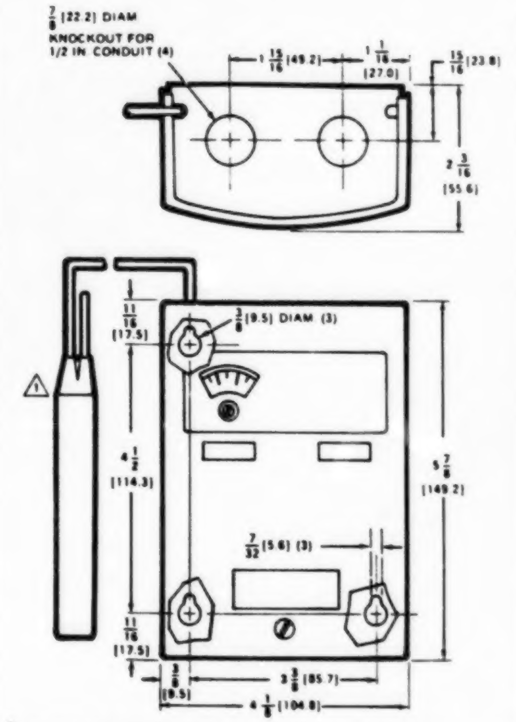
**WEIGHT:** T991E–2 lb [0.91 kg]; T991F–2.5 lb [1.13 kg].

**FINISH:** Gray cover, zinc-plated case.

**APPROVALS:**
UNDERWRITERS LABORATORIES INC. LISTED: File No. E4436, Guide No. XAPX.
CANADIAN STANDARDS ASSOCIATION CERTIFIED: File No. LR1620, Guide No. 400-E-0.

**ACCESSORIES:**

1. Immersion Well Assembly, to protect sensing bulb from mechanical or chemical damage when mounting in a boiler or storage tank; copper; 4-3/4 inch [120.7 mm] insertion length; includes 112721 Tube Clip for clamping capillary tube to immersion well–
   - –Part No. 112622AA, 1/2-14 NPT external threads on spud.
   - –Part No. 112630AA, 3/4-14 NPT external threads on spud.
2. Capillary Compression Fitting, to provide seal-off when mounting sensing bulb directly in a boiler or storage tank; brass; rated at 50 psi [344.7 kPa] water pressure or 15 psi [103.4 kPa] air pressure for sealing off sensing tube–
   - –Part No. 104484A, 1/2-14 NPT external threads on spud.
   - –Part No. 104484B, 3/4-14 NPT external threads on spud.
3. 107324A Capillary Holder, for mounting sensing bulb in an air duct; 8-3/8 inches [212.7 mm] long.
4. 34886A Bulb Shield, for mounting sensing bulb outdoors.
5. 105900 T-Strap, for clamping sensing bulb to a pipe or similar mount.
6. 120650 Tube of Heat Conductive Grease, for reducing response time when mounting sensing bulb in immersion well.
7. 801534 Calibration Wrench.



⚠1 T991F (WITH AUTOMATIC RESET) HAS 2 REMOTE SENSING BULBS

FIG. 1–APPROXIMATE DIMENSIONS OF THE T991E AND F PROPORTIONING TEMPERATURE CONTROLLERS, IN INCHES [MILLIMETRES IN BRACKETS].

# INSTALLATION

### WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced, service technician.
4. After installation is complete, check out product operation as provided in these instructions.

**CAUTION**

1. Disconnect all power to the controller before beginning installation to prevent electrical shock and equipment damage.
2. All wiring must comply with applicable local electrical codes, ordinances, and regulations.
3. The potentiometer (B, R, and W terminals) must be connected only to a low voltage (24 volts ac), series 90 device.
4. Loads connected to the end switch must not exceed those listed in the SPECIFICATIONS section.

**IMPORTANT**

1. Before using this controller in a new boiler installation, consult the boiler manufacturer.
2. Do not bend the capillary tubing into a radius of less than 1/2 inch [12.7 mm]. Repeated bending of the capillary will "work harden" the tubing, causing it to become brittle and break. Do not pull on the capillary at the controller.
3. Make sure excess wire and capillary tubing does not interfere with the end switch linkage.

## LOCATION

The T991 case may be mounted in any convenient position on a flat surface, such as a wall or panel, where the ambient temperature does not exceed 125 F [52 C]. If the mounting surface is hot or cold, insulate the case from it by insulation material (such as a wooden board), or offset the case to allow a space for air circulation. The location selected should be vibration free.

The capillary tube allows remote mounting of the sensing bulb(s). The length of tubing on the bulb(s) may limit the choice of locations. *Sharp bends or kinks in the capillary tubing could seriously affect the operation or calibration of the controller, and must be carefully avoided.* Excess tubing should be carefully coiled and left beside the T991.

The sensing bulb(s) must be located where the maximum ambient temperature will not exceed the maximum safe bulb temperature listed in Table I in the SPECIFICATIONS section. The bulb(s) should be located where it is exposed to the average temperature of the controlled medium.

## MOUNTING THE CONTROLLER

Refer to Fig. 1 for location of the 3, slotted mounting holes. Remove the cover from the controller and fasten the case securely to a flat surface. The controller may be mounted in any position.

## MOUNTING THE SENSING BULB IN A BOILER OR STORAGE TANK

The manufacturer of a boiler or storage tank usually provides a tapping for insertion of the sensing bulb. Follow the manufacturer's instructions if available. If the boiler or tank is filled, drain it until the level of the liquid is below the tapping in the boiler or tank. Remove the plug from the tapping, and screw the spud of the immersion well or compression fitting into the tapping. A reducer fitting may be necessary to adapt the spud to the tapping. Make sure the well or fitting is screwed in tightly to prevent leakage. Install the sensing bulb and controller. Then refill the boiler or tank. *Do not try to tighten the well or fitting in the tapping by turning the controller.*

### USE OF AN IMMERSION WELL (FIG. 2)

An immersion well (separable well) is used to protect the sensing bulb from mechanical or chemical damage, and to permit easy removal of the bulb from the liquid without having to drain the boiler or tank. In addition, it provides a tighter fitting than other mounting methods. An immersion well is very desirable for mounting the bulb in an agitated liquid.

The immersion well must be mounted where it is always exposed to the circulation of the liquid under control, but it must never be located close to a hot or cold inlet or steam coil.

The use of an immersion well more than doubles the response time compared to that for a bare bulb. Therefore, the well must fit the bulb snugly. It may be desirable to fill the space between the bulb and the well with a heat-conductive compound. The use of a heat-conductive grease will reduce the response time to about 1-1/2 times that for a bare bulb.

### TO INSTALL AN IMMERSION WELL:

1. Drain the system.
2. Screw the spud of the immersion well into the boiler or tank tapping (or reducer fitting, if one is required).

3. Insert the sensing bulb into the well until it bottoms.

4. If desired, fill the space between the bulb and the well with heat-conductive grease (Part No. 120650).

5. Fit the tube clip over the capillary tubing and clip it onto the end of the spud.

6. Coil excess capillary tubing at the T991 case.

7. Refill the system and check for leaks.

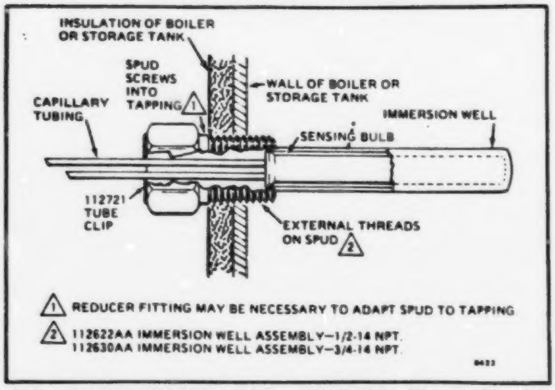

INSULATION OF BOILER OR STORAGE TANK
SPUD SCREWS INTO TAPPING 1
CAPILLARY TUBING
WALL OF BOILER OR STORAGE TANK
IMMERSION WELL
SENSING BULB
112721 TUBE CLIP
EXTERNAL THREADS ON SPUD 2
1 REDUCER FITTING MAY BE NECESSARY TO ADAPT SPUD TO TAPPING
2 112622AA IMMERSION WELL ASSEMBLY—1/2-14 NPT.
112630AA IMMERSION WELL ASSEMBLY—3/4-14 NPT.

FIG. 2—MOUNTING THE SENSING BULB IN AN IMMERSION WELL.

### USE OF A CAPILLARY COMPRESSION FITTING (FIG. 3)

A capillary compression fitting can be used to form a positive seal in applications where the bulb can be immersed directly in the liquid without danger of mechanical or chemical damage.

TO INSTALL A CAPILLARY COMPRESSION FITTING:

1. Drain the system.

2. Screw the spud of the compression fitting into the boiler or tank tapping (or reducer fitting, if one is required).

3. Run the capillary tubing through the packing nut.

4. Slide the sensing bulb completely through the spud.

5. Place the composition disc and 4 slotted brass washers on the capillary tubing in the order shown in Fig. 3.

6. Slide the disc and washers into the spud, and tighten the packing nut.

7. Coil excess capillary tubing at the T991 case.

8. Refill the system and check for leaks.

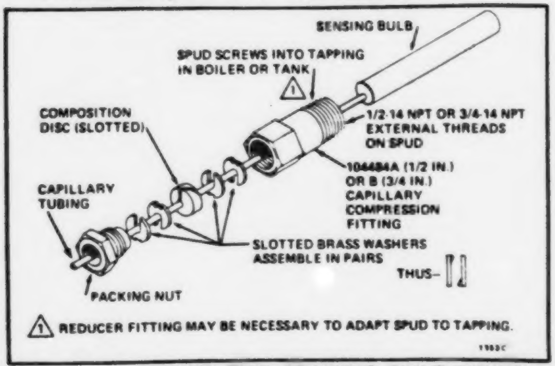

SENSING BULB
SPUD SCREWS INTO TAPPING IN BOILER OR TANK 1
COMPOSITION DISC (SLOTTED)
1/2-14 NPT OR 3/4-14 NPT EXTERNAL THREADS ON SPUD
104484A (1/2 IN.) OR B (3/4 IN.) CAPILLARY COMPRESSION FITTING
CAPILLARY TUBING
SLOTTED BRASS WASHERS ASSEMBLE IN PAIRS
THUS—
PACKING NUT
1 REDUCER FITTING MAY BE NECESSARY TO ADAPT SPUD TO TAPPING.

FIG. 3—MOUNTING THE SENSING BULB USING A CAPILLARY COMPRESSION FITTING.

## MOUNTING THE SENSING BULB IN AN AIR DUCT

The sensing bulb should be located where air of average temperature can circulate freely around it. Avoid mounting the bulb close to hot pipes, cooling coils, the combustion chamber, and other places where the air temperature is not representative.

### USE OF A CAPILLARY HOLDER (FIGS. 4-6)

A capillary holder and plate assembly is used to support and protect the capillary and bulb in the duct, and to prevent excessive air leakage. The holder should be long enough to hold the bulb in freely circulating air, away from the duct wall. If it is too long, it may easily be broken off to the proper length.

TO INSTALL A CAPILLARY HOLDER:

1. Drill a 3/4 inch [19.1 mm] hole in the wall of the duct to admit the sensing bulb and capillary holder.

2. Using the holder plate as a template, mark and drill holes for the 2 mounting screws.

3. Break off the capillary holder to the desired length (Fig. 4).

NOTE: The capillary holder should be long enough to hold the sensing bulb in freely circulating air, away from the duct wall.

4. Place the capillary tubing in the bulb holder channel, and pinch the top edges of the holder together at each segment (Fig. 5).

5. Insert the bulb and holder into the controlled area through the hole prepared in step 1 (Fig. 6, page 6).

6. Fasten the holder plate to the duct wall with the 2 mounting screws furnished.

7. Coil excess capillary tubing at the T991 case.

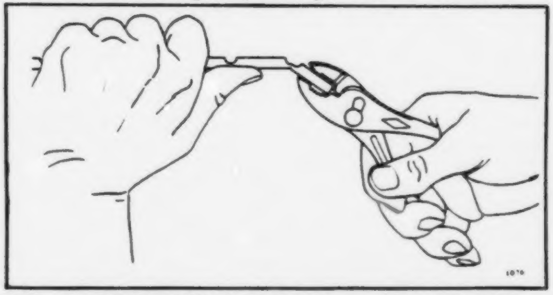


FIG. 4—SHORTENING THE CAPILLARY HOLDER.

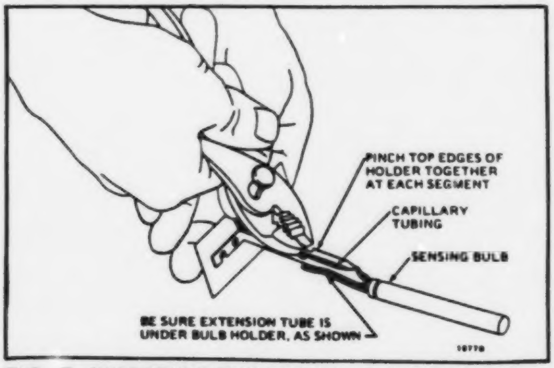

PINCH TOP EDGES OF HOLDER TOGETHER AT EACH SEGMENT
CAPILLARY TUBING
SENSING BULB
BE SURE EXTENSION TUBE IS UNDER BULB HOLDER, AS SHOWN

FIG. 5—INSERTING THE CAPILLARY IN THE CAPILLARY HOLDER.

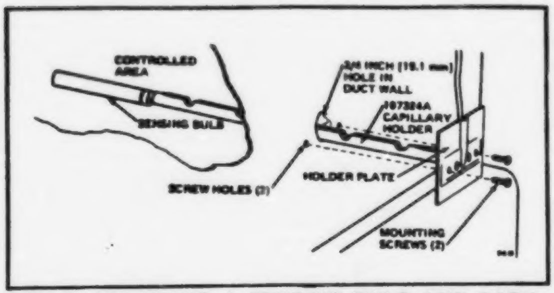

CONTROLLED AREA
SENSING BULB
SCREW HOLES (2)
3/4 INCH [19.1 mm] HOLE IN DUCT WALL
107324A CAPILLARY HOLDER
HOLDER PLATE
MOUNTING SCREWS (2)

FIG. 6—MOUNTING A SENSING BULB AND CAPILLARY HOLDER IN AN AIR DUCT.

## MOUNTING THE OUTDOOR SENSING BULB (T991F ONLY)

To obtain automatic reset of the control point, the outdoor sensing bulb on the T991F must be mounted in an outdoor air duct or outdoors. It can be mounted in an air duct using a capillary holder (Figs. 4-6). To mount it outdoors, use a bulb shield to protect the bulb from damage.

NOTE: The outdoor bulb is the one with the longest capillary (30 feet [9.1 metres]).

### USE OF A BULB SHIELD (FIGS. 7-8)

The bulb should be mounted under the shield in a horizontal position on the outside of the building where it will be exposed to representative air temperature, but not to direct sunlight. (However, for structures with large glass areas which absorb more radiant heat from the sun, it may be preferable to mount the bulb where it will be exposed to the same heating effect.) It should be mounted high enough so that it cannot be covered with snow, ice, leaves, or other debris, and so it cannot be tampered with. Vents from the building should be avoided.

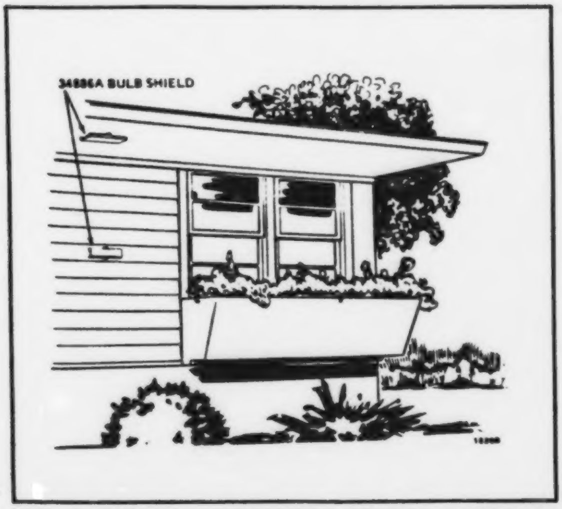

34886A BULB SHIELD

FIG. 7—TYPICAL LOCATIONS OF THE OUTDOOR BULB SHIELD.

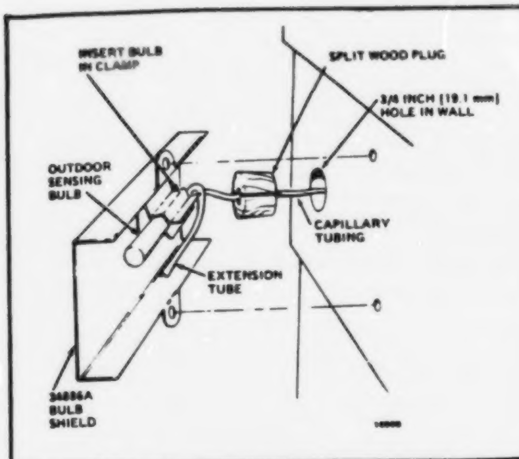
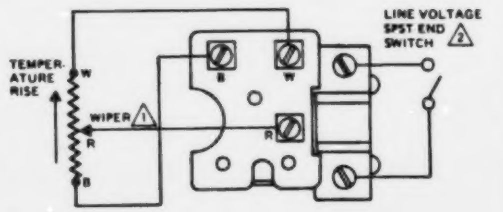

INSERT BULB IN CLAMP
SPLIT WOOD PLUG
3/4 INCH [19.1 mm] HOLE IN WALL
OUTDOOR SENSING BULB
CAPILLARY TUBING
EXTENSION TUBE
34886A BULB SHIELD

FIG. 8—MOUNTING THE T991F OUTDOOR SENSING BULB OUTDOORS USING A BULB SHIELD.

## WIRING

*Disconnect the power supply before making wiring connections to prevent electrical shock and equipment damage.* All wiring must comply with applicable electrical codes, ordinances, and regulations. If using the T991 with a flame safeguard control, use moisture-resistant No. 14 wire suitable for at least 167 F [75 C] for a primary control (such as an RA890), or for at least 194 F [90 C] for a programming control (such as an R4140). *For high temperature installations,* use moisture-resistant No. 14 wire selected for a temperature rating above the maximum operating temperature.

The internal schematic is shown in Fig. 9. A typical flame safeguard application is shown in Fig. 10. A typical *fuel-saving* application of the T991F Dual Bulb Proportioning Temperature Controller is shown in Fig. 11. Also refer to instructions furnished by the system equipment manufacturer. In a replacement application, make sure the T991 is wired into the system to operate the same way as the old controller. *When wiring the T991, make sure excess wire and capillary tubing does not interfere with the end switch linkage.*


LINE VOLTAGE SPST END SWITCH 2
TEMPERATURE RISE
W
WIPER 1
R
B
B
W
R

1 WIPER MOVES TOWARD "W" ON TEMPERATURE RISE; TOWARD "B" ON TEMPERATURE FALL.

2 END SWITCH MAKES ON TEMPERATURE FALL TO A POINT ABOVE THE PROPORTIONING RANGE. "MAKE" POINT IS ADJUSTABLE FROM 1 TO 4 DEGREES F [0.6 TO 2.2 DEGREES C] ABOVE THE HIGH TEMPERATURE (LOW FIRE) END OF THE PROPORTIONING RANGE.

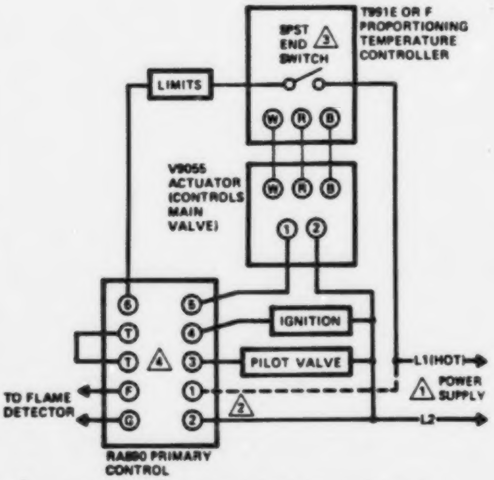
FIG. 9—INTERNAL SCHEMATIC OF A T991E OR F PROPORTIONING TEMPERATURE CONTROLLER.

### COMBINATION ON-OFF AND FIRING RATE CONTROL USING A T991E OR F (FIG. 10)

For economy, it may be desirable to use the same controller to turn the burner on and off, and also to regulate the firing rate. A T991E or F can be used to accomplish these functions.

Fig. 10 shows a T991E or F connected directly to a V9055 Modulating Fluid Power Gas Valve Actuator to regulate the firing rate. When the temperature is warm enough, the end switch will be open so the RA890 will not be energized and the burner will be shut down. When the temperature falls, the end switch makes, energizing the RA890 and starting the burner. When the pilot flame is detected, internal switching applies power to terminal 5 of the RA890, energizing the V9055 actuator.

The temperature is still above the proportioning range of the temperature controller, so its wiper will be all the way over to the W end of the potentiometer. The actuator and main valve will be at the low fire position (closed or nearly closed). If the temperature continues to fall until it is within the proportioning range of the temperature controller, the controller will regulate the position of the actuator and main valve, and thus modulate the firing rate. If the temperature rises too high, even with the system at low fire, the end switch will break, de-energizing the RA890 and shutting down the burner.


T991E OR F PROPORTIONING TEMPERATURE CONTROLLER
SPST END SWITCH 3
LIMITS
W
R
B
V9055 ACTUATOR (CONTROLS MAIN VALVE)
W
R
B
1
2
6
T
T
4
F
G
5
4
3
1
2
IGNITION
PILOT VALVE
L1(HOT)
1 POWER SUPPLY
2
L2
TO FLAME DETECTOR
RA890 PRIMARY CONTROL

1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 CONNECTION TO TERMINAL 1 (SHOWN BY DASHED LINE) IS ALSO REQUIRED ON AN RA890E OR G.

3 BREAKS ON TEMPERATURE RISE, MAKES ON TEMPERATURE FALL. IF TEMPERATURE FALLS FURTHER, FIRING RATE IS MODULATED.

4 FOR DETAILED CIRCUIT INFORMATION, REFER TO THE RA890 INSTRUCTION SHEET OR HANDBOOK.

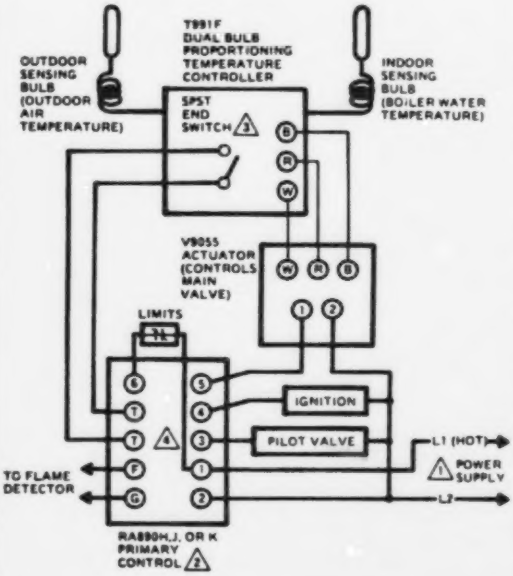
FIG. 10—TYPICAL FLAME SAFEGUARD APPLICATION OF A T991E OR F—PROVIDING COMBINATION ON-OFF AND FIRING RATE CONTROL.

### AUTOMATIC RESET OF BOILER WATER TEMPERATURE USING A T991F (FIG. 11)

The T991F Dual Bulb Proportioning Temperature Controller can be used to save fuel by proportioning the firing rate and providing automatic reset of the boiler water temperature.

Fig. 11 shows a T991F connected directly to a V9055 Modulating Fluid Power Gas Valve Actuator to regulate the firing rate. The connections are similar to Fig. 10 except that the end switch is connected in the low voltage circuit of the RA890 instead of in series with the limits. An RA890H, J, or K must be used in this application.

Operation is the same as that described for Fig. 10 except for automatic reset of the control point. When the outdoor temperature falls, the control point temperature will be automatically increased. The boiler water temperature will increase to take care of the increased heating load. When the outdoor temperature rises again, the boiler temperature will decrease automatically.


OUTDOOR SENSING BULB (OUTDOOR AIR TEMPERATURE)
T991F DUAL BULB PROPORTIONING TEMPERATURE CONTROLLER
INDOOR SENSING BULB (BOILER WATER TEMPERATURE)
SPST END SWITCH 3
B
R
W
V9055 ACTUATOR (CONTROLS MAIN VALVE)
W
R
B
1
2
LIMITS
6
T
T
4
F
G
5
4
3
1
2
IGNITION
PILOT VALVE
L1 (HOT)
1 POWER SUPPLY
L2
TO FLAME DETECTOR
RA890H, J, OR K PRIMARY CONTROL 2

1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 REPLACES AN RA890E OR F.

3 BREAKS ON TEMPERATURE RISE, MAKES ON TEMPERATURE FALL. IF TEMPERATURE FALLS FURTHER, FIRING RATE IS MODULATED.

4 FOR DETAILED CIRCUIT INFORMATION, REFER TO THE RA890 INSTRUCTION SHEET OR HANDBOOK.

FIG. 11—TYPICAL FUEL-SAVING APPLICATION OF A T991F—PROPORTIONED FIRING RATE AND AUTOMATIC RESET OF BOILER WATER TEMPERATURE.

# SETTING AND CHECKOUT

**CAUTION**

**Disconnect all power to the controller before removing the cover, adjusting the end switch, or checking out the controller internally. With power connected, line voltage may be present at the end switch terminals.**

**IMPORTANT**

**Before changing the prescribed set point on an existing boiler installation, consult the boiler manufacturer.**

## SETTING THE T991E OR F

### SET POINT (FIG. 12)

Adjust the set point for the desired operating temperature by turning the set point adjusting screw on the front of the case until the desired value is reached on the set point indicating dial. The set point is calibrated to be at the center of the proportioning range (Fig. 13).

On a T991F, this set point will be the control temperature of the heating medium (e.g., boiler water) when the outdoor air temperature is at 70 F [21 C]. For the standard reset ratio of 1:1, if the outdoor air temperature falls 10 degrees F [5.6 degrees C] below 70 F [21 C], the temperature of the heating medium will increase 10 degrees F [5.6 degrees C] above the set point.

From an economical standpoint, it is desirable to operate the heating equipment at a minimum temperature when the weather is mild, and to operate near full capacity when the most severe weather is encountered. Therefore, the T991F should ordinarily be set near the low end of the operating range.

If in doubt as to the correct initial temperature set point, it is better to start on the low side of the range and increase the setting; a need for additional heat is easily detected. Too high an initial set point is difficult to detect, reduces economy, and results in poor control.

### PROPORTIONING (THROTTLING) RANGE

The proportioning range (Fig. 13) is *not* adjustable. It is fixed at 11 degrees F [6 degrees C], so it extends 5.5 degrees F [3 degrees C] above and below the set point.

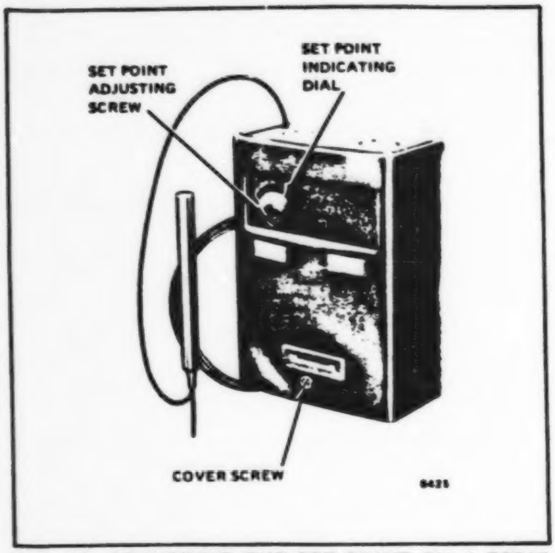
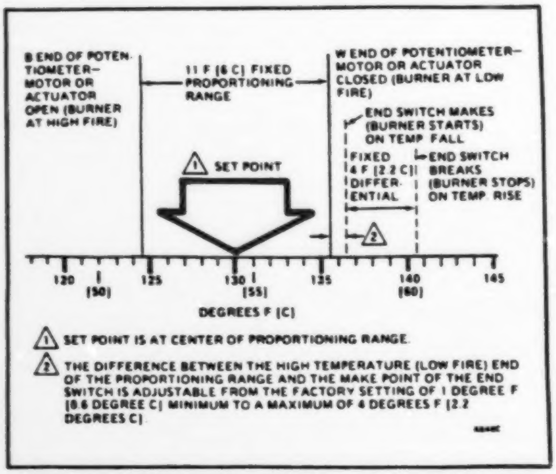

SET POINT ADJUSTING SCREW
SET POINT INDICATING DIAL
COVER SCREW
8425

FIG. 12—ADJUSTING THE SET POINT ON A T991E OR F.


B END OF POTENTIOMETER—MOTOR OR ACTUATOR OPEN (BURNER AT HIGH FIRE)
11 F (6 C) FIXED PROPORTIONING RANGE
W END OF POTENTIOMETER—MOTOR OR ACTUATOR CLOSED (BURNER AT LOW FIRE)
END SWITCH MAKES (BURNER STARTS) ON TEMP. FALL
FIXED 4 F (2.2 C) DIFFERENTIAL
END SWITCH BREAKS (BURNER STOPS) ON TEMP. RISE
1 SET POINT
2
120
(50)
125
130
(55)
135
140
(60)
145
DEGREES F (C)

1 SET POINT IS AT CENTER OF PROPORTIONING RANGE.

2 THE DIFFERENCE BETWEEN THE HIGH TEMPERATURE (LOW FIRE) END OF THE PROPORTIONING RANGE AND THE MAKE POINT OF THE END SWITCH IS ADJUSTABLE FROM THE FACTORY SETTING OF 1 DEGREE F [0.6 DEGREE C] MINIMUM TO A MAXIMUM OF 4 DEGREES F [2.2 DEGREES C].

FIG. 13—OPERATING POINTS OF A T991E OR F.

## END SWITCH ADJUSTMENTS

To adjust the end switch, *disconnect all power* to the T991, loosen the cover screw (Fig. 12), and remove the cover. The adjustment screw is on the side of the switch below the terminals.

### END SWITCH "MAKE" POINT (FIG. 14)

On a T991E or F, the temperature difference between the high temperature (low fire) end of the proportioning range and the point at which the end switch makes is adjustable. It can be increased from the factory setting of 1 degree F [0.6 degree C] minimum to a maximum of 4 degrees F [2.2 degrees C] by turning the end switch adjustment screw (Fig. 14) counterclockwise ↶

(backing the screw out), but *no more than 1/16 of a turn at one time. Do not turn the adjustment screw clockwise* ↷. The end switch will not operate properly if the adjustment screw is turned clockwise past the factory-set position.

**CAUTION**

Do NOT turn the end switch adjustment screw counterclockwise ↶ more than 1/16 of a turn at one time. *Do not turn the adjustment screw clockwise* ↷. If the adjustment screw is turned in a clockwise direction beyond the factory-set position, the end switch *will not* cycle the burner properly.

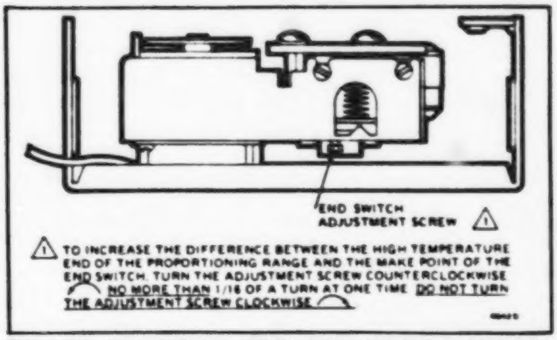

END SWITCH
ADJUSTMENT SCREW ⚠
⚠ TO INCREASE THE DIFFERENCE BETWEEN THE HIGH TEMPERATURE END OF THE PROPORTIONING RANGE AND THE MAKE POINT OF THE END SWITCH, TURN THE ADJUSTMENT SCREW COUNTERCLOCKWISE ↶ NO MORE THAN 1/16 OF A TURN AT ONE TIME. DO NOT TURN THE ADJUSTMENT SCREW CLOCKWISE ↷

FIG. 14—ADJUSTING THE END SWITCH "MAKE" POINT.

## END SWITCH DIFFERENTIAL

The end switch differential between its make and break points is *not* adjustable. It is fixed at 4 degrees F [2.2 degrees C].

## CHECKOUT

After the controller has been installed, wired, and set, it should be tested with the system in operation. First allow the system to stabilize. Then observe the operation of the controller while raising and lowering its set point. Temperature should increase when the set point is raised and decrease when the set point is lowered. Use accurate temperature testing equipment when checking out the controller. Do not rely on inexpensive gauges. The controllers are carefully calibrated at the factory.

## CHECKING THE PROPORTIONING ACTION

Make sure the modulating motor or modulating valve actuator reaches the low and high fire positions at the proper points. If the motor or actuator runs in the proper direction when the set point is adjusted, it can be assumed that the controller is operating properly. If it runs in the wrong direction, reverse the B and W wires. Observe the action of the motor or actuator to see if it stabilizes.

If the proportioning controller is suspected of operating improperly, it may be further checked as follows (Fig. 15):

1. *Disconnect all power to the controller,* loosen the cover screw (Fig. 12), and remove the cover.
2. Disconnect the wires from the controller.
3. Connect an ohmmeter between controller terminals B and W to measure the resistance of the potentiometer in the controller. The ohmmeter should read about 135 ohms.
4. Connect the ohmmeter between controller terminals W and R and raise the set point of the controller at least 6 degrees F [3.3 degrees C] above the actual temperature being measured. The ohmmeter should read the full value of the potentiometer measured in step 2 (135 ohms).
5. Slowly lower the set point of the controller while observing the ohmmeter reading. The resistance should drop to zero at some set point below the actual temperature.
6. An approximation of the proportioning range can be made by observing the change in set point required for a resistance change from zero to full value.

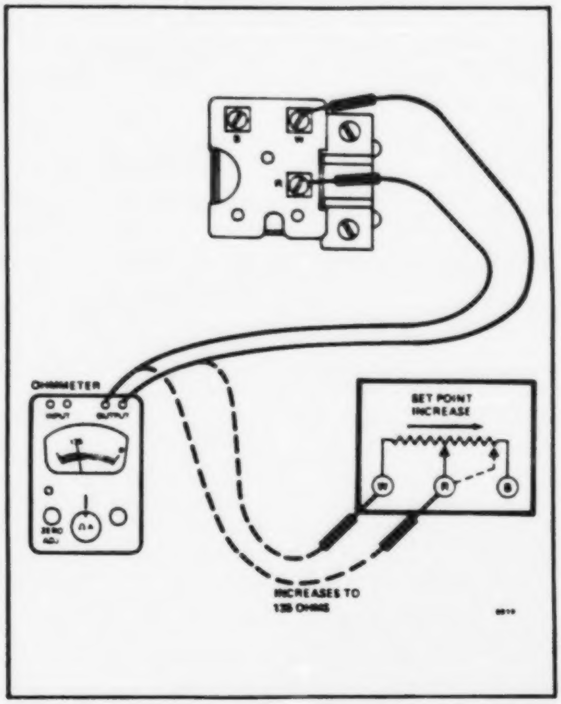


FIG. 15—CHECKING THE PROPORTIONING RANGE.

## CHECKING THE END SWITCH

Make sure the end switch makes and breaks at the proper points. Be sure to consider the differential. If the controller is suspected of operating improperly, it may be further checked as follows (Fig. 16):

1. *Disconnect all power to the controller,* loosen the cover screw (Fig. 12), and remove the cover.
2. Disconnect the wires from the controller.
3. Connect an ohmmeter between the end switch terminals.
4. Lower the set point of the controller at least 14 degrees F [8 degrees C] below the actual temperature being measured. The switch should break (the ohmmeter should read infinity).

*(continued on page 10)*

5. Raise the set point of the controller more than the differential (at least 5 degrees F [3 degrees C]). The switch should make (the ohmmeter should read zero).

6. An approximation of the differential can be made by observing the change in set point required for a resistance change from zero to infinity.

**CAUTION**

Do not put the system into service until you have satisfactorily completed all applicable tests described in this CHECKOUT section, in the CHECKOUT section of the applicable instruction sheet for the flame safeguard control, and any others required by the burner manufacturer.

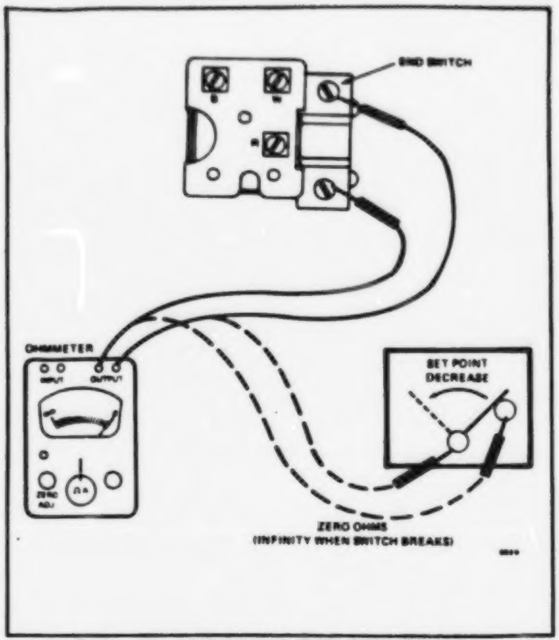


FIG. 16—CHECKING THE END SWITCH.

# CALIBRATION

**CAUTION**

1. Disconnect all power to the controller before beginning a calibration check. With power connected, line voltage may be present at the end switch terminals.
2. Disconnect all controlled equipment before beginning a calibration check.

The T991 is carefully calibrated at the time of manufacture and will maintain adjustment for years of normal service. Poor control can be the result of many factors, and field recalibration is not recommended. If reason exists for verifying calibration, this can be performed with reasonable accuracy with a good thermometer and an ohmmeter.

## T991E CALIBRATION CHECK AND ADJUSTMENT (FIG. 17)

1. Determine the temperature as accurately as possible at the sensing bulb. If it is not possible to determine the temperature accurately, remove the bulb and immerse it in water at a temperature near the midrange of the T991E temperature dial.

NOTE: Allow the bulb to remain in the water for a minimum of 15 minutes. Then determine the water temperature with an accurate thermometer.

2. *Disconnect all power to the controller,* loosen the cover screw (Fig. 12), and remove the cover.

3. Connect an ohmmeter between terminals R and W of the T991E.

4. Rotate the T991E temperature dial clockwise ↷ , if necessary, to obtain a zero (0) reading on the ohmmeter.

5. Rotate the dial counterclockwise ↶ , simulating a temperature fall, until the ohmmeter reads 67.5 ohms.

6. Note the dial reading of the T991E. If it differs from the bulb temperature, recalibrate the controller as follows.

7. Determine the number of degrees difference between the T991E dial reading and the bulb temperature.

8. Insert the calibration wrench (accessory, Part No. 801534) into the slots of the dial. Rotate the dial until the tabs of the wrench drop into the slots of the calibration nut under the dial.

9. Note the dial reading at this point. Turn the dial *and* the nut together up or down the number of degrees that the T991E dial reading differs from the thermometer reading (step 7).

FOR EXAMPLE: Turn the dial from 45 to 65 degrees if the bulb temperature is 20 degrees higher than the dial reading.

10. Check the calibration by repeating steps 1 through 6.

11. If the T991E is still out of calibration, repeat the recalibration procedure.

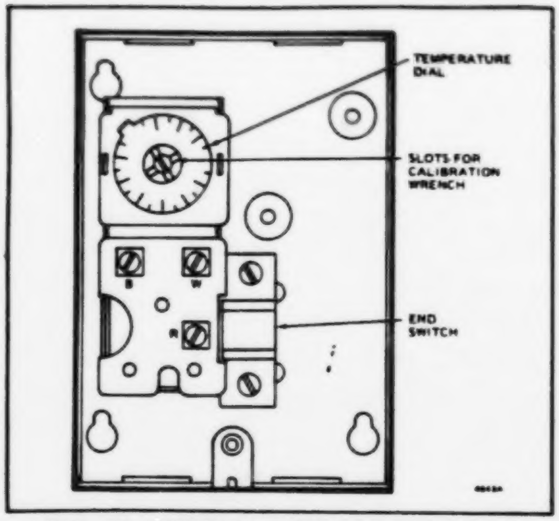


FIG. 17—INTERNAL VIEW OF A T991E OR F.

## T991F CALIBRATION CHECK AND ADJUSTMENT (FIG. 17)

**IMPORTANT**

Calibration must be performed at an outdoor air temperature of 70 F [21 C] or below.

1. Determine the outdoor air temperature as accurately as possible at the *location of the outdoor bulb*. Subtract this temperature from 70 F [21 C] (the calibration reference point of the T991F) to find the DIFFERENCE TEMPERATURE.

2. Multiply the DIFFERENCE TEMPERATURE by the RESET FACTOR (see table below) to find the amount of shift, or "reset," in the control point.

| RESET RATIO | RESET FACTOR |
|---|---|
| 1:1 | 1.00 |
| 1:1.5 | 1.50 |
| 1.5:1 | 0.67 |
| 3.5:1 | 0.29 |

3. Determine the temperature of the heating medium at the indoor bulb and subtract the amount of the control point reset (step 2) to find the THEORETICAL SET POINT.

NOTE: An alternative to performing steps 1 through 3 is to place both bulbs in a 70 F [21 C] water bath. Leave them in the water bath for at least 15 minutes before proceeding.

4. *Disconnect all power to the controller*, loosen the cover screw (Fig. 12), and remove the cover.

5. Connect an ohmmeter between terminals R and W of the T991F.

6. Rotate the T991F temperature dial clockwise ↷ , if necessary, to obtain a zero (0) reading on the ohmmeter.

7. Rotate the dial counterclockwise ↶ , simulating a temperature fall, until the ohmmeter reads 67.5 ohms.

8. Note the dial reading of the T991F. If it differs from the THEORETICAL SET POINT (or the temperature of the water bath), recalibrate the controller as follows.

9. Determine the number of degrees difference between the T991F dial reading and the THEORETICAL SET POINT (or the temperature of the water bath).

10. Insert the calibration wrench, Part No. 801534, into the slots of the dial. Rotate the dial until the tabs of the wrench drop into the slots of the calibration nut under the dial.

11. Note the dial reading at this point. Turn the dial and the nut together up or down the number of degrees that the T991F dial reading differs from the THEORETICAL SET POINT (or the temperature of the water bath) in step 9.

FOR EXAMPLE: Turn the dial from 45 to 65 degrees if the THEORETICAL SET POINT or the temperature of the water bath is 20 degrees higher than the dial reading.

12. Check the calibration by repeating steps 1 through 8.

13. If the T991F is still out of calibration, repeat the recalibration procedure.

# OPERATION

## PROPORTIONING RANGE

The T991E and F Proportioning Temperature Controllers have a *fixed* proportioning range of 11 degrees F [6 degrees C]. The proportioning range (also called throttling range) extends 5.5 degrees F [3 degrees C] on both sides of the set point (Fig. 13).

Temperature variations cause the liquid in the sensing bulb(s) to expand or contract. This change is transmitted to the diaphragm in the case by the capillary tubing. The potentiometer wiper (R terminal) is operated by the diaphragm through an adjustable parallel lever arrangement. When the diaphragm moves, the wiper moves across the windings in the potentiometer (Fig. 9). This varies the resistance between R and B, and R and W. The resulting circuit unbalance drives a modulating motor or modulating valve actuator and regulates the firing rate.

As the temperature rises, the wiper will move toward the W end of the potentiometer, driving the motor or actuator toward its closed position and decreasing the firing rate. As the temperature falls, the wiper will move toward the B end, driving the motor or actuator toward its open position and increasing the firing rate. Thus, a change in the temperature will cause modulation of the firing rate to compensate for the change and keep the temperature nearly constant at the set point.

*(continued on page 12)*

The proportioning range is the difference in temperature represented by the total potentiometer resistance. When the potentiometer wiper moves all the way to the W end, the motor or actuator will be fully closed and the burner will be at low fire. This will occur when the controlled temperature rises 5.5 F [3 C] above the set point. Similarly, when the potentiometer wiper moves all the way to the B end, the motor or actuator will be fully open and the burner will be at high fire. This will occur when the controlled temperature falls 5.5 F [3 C] below the set point.

For example, in Fig. 13, the set point is at 130 F [54.4 C]. The controller will modulate between its fully open (high fire) position at 124.5 F [51.4 C] and its fully closed (low fire) position at 135.5 F [57.5 C].

## END SWITCH

The spst end switch in a T991E or F can be used as an operating controller to shut down the burner when the temperature is warm enough, and to start the burner when the temperature falls through the differential. It can also be used as a high limit to shut down the burner if the temperature gets too high. If the temperature falls into the proportioning range of the controller, the firing rate of the burner will be modulated, as described previously.

For example, in Fig. 13, the burner will be shut down when the temperature rises to 140.5 F [60.3 C]. When the temperature falls 4 degrees F [2.2 degrees C] through the differential of the end switch to 136.5 F [58.1 C], the burner will be started again. If the temperature continues to fall below 135.5 F [57.5 C], the firing rate of the burner will be modulated.

## AUTOMATIC RESET OF THE CONTROL POINT (T991F ONLY)

The T991F Dual Bulb Proportioning Temperature Controller monitors the outdoor temperature to determine the need for a change in indoor temperature. The T991F automatically adjusts the control point of the furnace or boiler to compensate for a change in the outdoor temperature. Automatic reset results in a more consistent comfort level in the living space.

The sensing element of a T991F consists of a single powerhead to which 2 remote, liquid-filled, sensing bulbs are connected by capillary tubing. The capillaries for the 2 bulbs are interconnected at the powerhead, so the diaphragm responds to both bulbs at the same time. To keep the diaphragm position constant, the total volume of liquid in the system must remain constant. If the temperature at one of the bulbs falls, the volume of liquid in the bulb contracts. Therefore the volume of liquid in the other bulb must expand the same amount to keep the diaphragm position constant. This requires a rise of temperature at the second bulb, resulting in an automatic increase of the control point of the temperature controller without readjusting the set point. This change in the control point is called reset.

In a typical heating system, reset is used to maintain boiler water at the desired temperature. The controller set point is adjusted for a relatively low boiler temperature during mild weather. When the outdoor temperature falls, the boiler temperature will be increased automatically to take care of the increased heating load. When the outdoor temperature rises again, the boiler temperature will decrease automatically. This enables the temperature controller to be set at the minimum required temperature and left there, while still allowing the system to provide enough heat for the most severe weather conditions. By keeping the boiler water temperature low, boiler standby heat loss and transmission loss from piping are reduced. The possibility of overheating the controlled space is minimized. Also, since the circulator pump runs longer, expansion and contraction noises are much less of a problem.

In a normal application, one bulb monitors the temperature of the outdoor air, and the other monitors the temperature of the heating medium (usually boiler water). If the temperature of the outdoor air falls, the temperature of the heating medium must rise to a new control point, and vice versa. The relationship between these two temperatures is expressed as a *reset ratio.*

RESET RATIO = CHANGE IN TEMPERATURE OF THE OUTDOOR AIR
: CHANGE IN CONTROL POINT TEMPERATURE OF THE HEATING MEDIUM.

FOR EXAMPLE:

2:1

CHANGE IN OUTDOOR TEMPERATURE — CHANGE IN CONTROL POINT

In this example, if the outdoor temperature falls 2 degrees, the control point increases 1 degree.

This is an *inverse* ratio—when the outdoor air temperature falls, the control point rises (and vice versa).

The table below shows the change in theoretical control point that would result from a change in outdoor air temperature of 20 degrees F [11 degrees C].

| RESET RATIO | SHIFT IN CONTROL POINT (NOMINAL) | |
|---|---|---|
| | F | C |
| 1:1.5 | 30 | 17 |
| 1:1 | 20 | 11 |
| 1.5:1 | 13 | 7 |
| 3.5:1 | 6 | 3 |

When the sensed outdoor temperature is *below* 70 F [21 C], each degree of fall causes a related *increase* in control point above the dial-indicated set point temperature. Thus, on a controller with a reset ratio of 1:1, an outdoor temperature of 50 F [10 C] will cause a reset of 20 degrees F [11 degrees C]. The control point will be 20 degrees F [11 degrees C] higher than the set point temperature indicated on the scale.

# SERVICE INFORMATION

**CAUTION**

1. Only qualified service technicians should attempt to service or repair flame safeguard controls and burner systems.
2. Disconnect all power to the controller before removing the cover. With power connected, line voltage may be present at the end switch terminals.

## MAINTENANCE

The cover of the controller should be in place at all times to protect the internal components from dirt, dust, and physical damage. Routine maintenance should consist of occasional inspection and blowing or brushing away any accumulated dirt and dust. To ensure proper functioning of the controller at all times, an operational check of the entire system should be performed during routine maintenance checks.

Occasionally, mishandling of the controller may cause a malfunction. A gradual change of control point may occur because of a very small leak in the thermal system. This is most likely to be caused by bending the capillary tubing too sharply, or too close to a joint. Aging at the factory would have revealed the leak if it had been present at the time of assembly. If the tubing is squeezed so hard or bent so sharply that its bore is completely closed up, the controller will, of course, be rendered entirely inoperative. Deforming the sensing bulb(s) will change the volume, resulting in a shift in calibration. These types of malfunctions should be looked for during maintenance. Controllers should be handled carefully at the time of installation, during actual use, and during maintenance.

## CLEANING THE POTENTIOMETER WINDINGS OR WIPER

Occasionally, the windings or wiper on the potentiometer may need cleaning. Use *only* Honeywell pressurized contact cleaner, Part No. 132569. Honeywell's chemical analysis laboratory has found this cleaner to be acceptable for this task. Directions for using this cleaner are printed on the can.

**IMPORTANT**

1. Use only Honeywell contact cleaner, Part No. 132569, to clean the potentiometer windings or wiper. Do not use any other type of contact cleaner.
2. Use utmost care to avoid bending the wiper or damaging the windings.
3. Do not use an abrasive or a burnishing tool to clean the potentiometer windings or wiper.
4. Do not use hard paper, such as a business card, to clean the potentiometer windings or wiper.

Do not use other types of contact cleaners. Honeywell's chemical analysis laboratory tested other pressurized type contact cleaners but did not approve them for these reasons:

1. The solvents could deteriorate plastic parts and wire insulation.
2. The cleaners leave an oily residue which will collect dust and dirt. The residue will also break down to form various carbonaceous products. Either result will cause early failure of the potentiometer.

Do not use an abrasive (sand paper stick, file, etc.) or a burnishing tool to clean the potentiometer windings or wiper. Use of an abrasive loosens fine particles which adhere to the surface of the windings or wiper, thus increasing the resistance between the windings and the wiper.

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Minneapolis, Minnesota 55408
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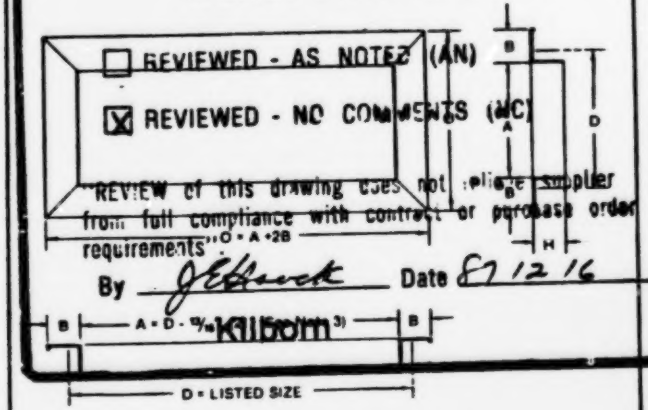
# Submittal Sheet

## SUPPLY GRILLES AND REGISTERS



VENDOR'S DOCUMENT REVIEW

☐ REVIEWED - AS NOTED (AN)

☒ REVIEWED - NO COMMENTS (NC)

"REVIEW of this drawing does not relieve supplier from full compliance with contract or purchase order requirements".

By JEHawk Date 87 12 16

Kilborn

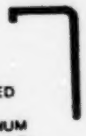
### NOTES & LIMITATIONS

1. Reference Catalogue D-1, Grilles & Registers.
2. Nominal Opening equals listed size except where noted otherwise.
3. ED Border must be used with V Mounting Frame for combination, A = D - 1¹³⁄₁₆" (46).
4. N Border must be used with W Mounting frame & H fastening.
5. For B dimensions see Border Details.
6. For H dimensions, see Core Style Details.
7. Louvre blades individually adjustable.
8. Countersunk screw holes for No. 8 S.M.S. - per factory standard.
9. Supply Grilles & Registers furnished complete with gasket.
10. Factory tolerance ± 1/32 (1).

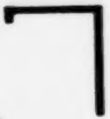
### FINISH

☒ B1 ALUMINUM BAKED ENAMEL
☐ OFF-WHITE BAKED ENAMEL
☐ PC15 ALUMINUM PRIME COAT, SUITABLE FOR FIELD PAINTING
☐ PPA PRE-TREATMENT FOR FIELD PAINTING (Aluminum Products Only)
☐ SPECIAL

### STANDARD BORDERS

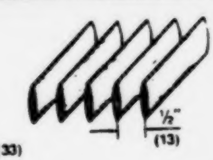
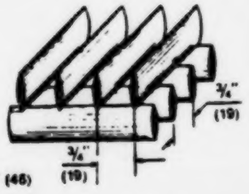
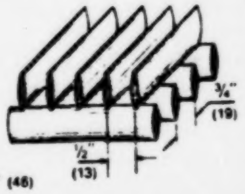
| | | | | |
|---|---|---|---|---|
| | CURVED FACE ALUMINUM | B = 1¼" (32) | ☐ | C |
| | NARROW MARGIN ALUMINUM | B = 1" (25) | ☐ | NM |
|  | EXPOSED DUCT ALUMINUM (See Note 3) | B = ¹³⁄₁₆" (21) | ☐ | ED |

### INDUSTRIAL BORDERS

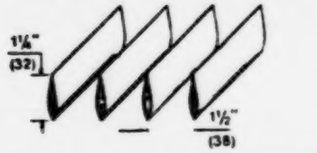
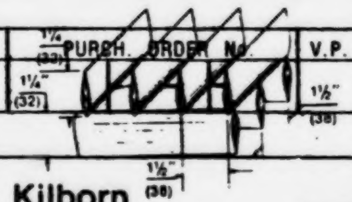
| | | | | |
|---|---|---|---|---|
|  | FLAT FACE ALUMINUM | B = 1¼" (32) | ☒ | F |
| | ALUMINUM (See Note 4) | B = ½" (13) | ☐ | N |

NOTE ALL METRIC DIMENSIONS ( ) ARE SOFT CONVERSION IMPERIAL DIMENSIONS ARE CONVERTED TO METRIC AND ROUNDED TO THE NEAREST MILLIMETER

### STANDARD CORE STYLES

| | | | | |
|---|---|---|---|---|
| | H = 1⁵⁄₁₆" (33) | USE WITH ALL BORDERS EXCEPT F & N | ☐ | 21 |
|  | H = 1⁵⁄₁₆" (33) | USE WITH ALL BORDERS EXCEPT F & N | ☐ | 31 |
|  | H = 1¹³⁄₁₆" (46) | USE WITH ALL BORDERS EXCEPT F & N | ☐ | 22 |
|  | H = 1¹³⁄₁₆" (46) | USE WITH ALL BORDERS EXCEPT F & N | ☐ | 32 |

### INDUSTRIAL CORE STYLES

| | | | | |
|---|---|---|---|---|
|  | H = 2⁵⁄₁₆" (59) | USE WITH BORDERS F & N ONLY | ☐ | 11 |
|  | H = 2⁵⁄₁₆" (59) | USE WITH BORDERS F & N ONLY | ☒ | 12 |

PROJ:

| | JOB No. | PURCH. ORDER No. | V.P. No. | REV |
|---|---|---|---|---|
| V.P. | | | | |

EQUIP. No.

Kilborn

| | | |
|---|---|---|
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| ENGINEER KILBORN | SKL | SUPPLY GRILLES & REGISTERS |
| CUSTOMER GEN AIR | 203510 | |
| SUBMITTAL DATE | SPEC. SYMBOL S-1 | Oct./86 |

**e.h.price**
**LIMITED**

# Submittal Sheet

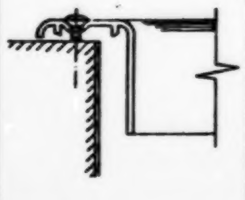
## OPTIONS & ACCESSORIES FOR SUPPLY GRILLES & REGISTERS

### FASTENING

NONE ☐

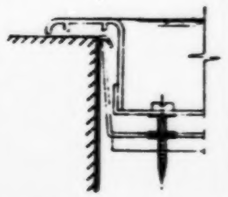
**SCREW MOUNTING**

**CONCEALED MOUNTING**



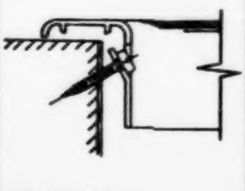
USE WITH
ALL BORDERS
EXCEPT N

☒ A



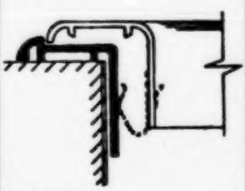
USE WITH
ALL BORDERS
EXCEPT N

☐ C



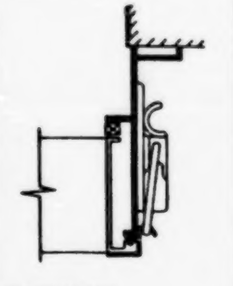
USE WITH C & NM
BORDERS ONLY
SEE LIMITATION
NOTES 1, 2, & 3

☐ G



USE WITH A
MOUNTING FRAME
SEE LIMITATION
NOTES 4 & 5

☐ SC

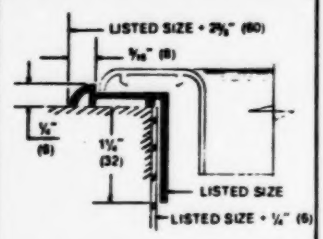


TRUNK LATCH
USE WITH N BORDER
& W MOUNTING
FRAME

☐ H

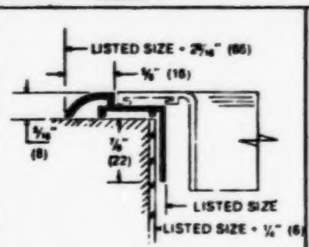
### MOUNTING FRAMES

NONE ☐


LISTED SIZE + 2⅜" (60)
5/16" (8)
¼" (6)
1¼" (32)
LISTED SIZE
LISTED SIZE + ¼" (6)

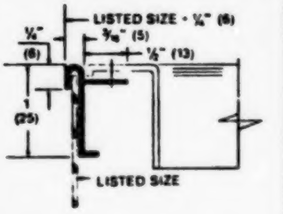
USE WITH C
BORDER ONLY
No 316 FRAME ALUM

☐ K


LISTED SIZE + 2 9/16" (65)
⅝" (16)
5/16" (8)
⅞" (22)
LISTED SIZE
LISTED SIZE + ¼" (6)

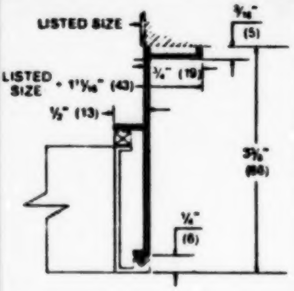
USE WITH NM
BORDER ONLY
No 883 FRAME ALUM

☐ T


LISTED SIZE + ¼" (6)
¼" (6)
3/16" (5)
½" (13)
1 (25)
LISTED SIZE

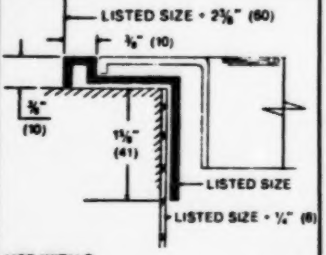
USE WITH ED
BORDER ONLY
No 884 FRAME ALUM

☐ V


LISTED SIZE
3/16" (5)
LISTED SIZE + 1 11/16" (43)
¾" (19)
½" (13)
3⅜" (86)
¼" (6)

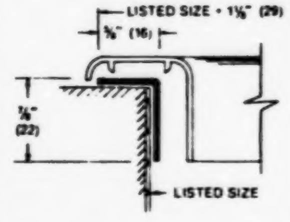
USE WITH N BORDER
& H FASTENING
No 1201 FRAME ALUM

☐ W


LISTED SIZE + 2⅜" (60)
⅜" (10)
⅜" (10)
1⅝" (41)
LISTED SIZE
LISTED SIZE + ¼" (6)

USE WITH F
BORDER ONLY
No. 115 FRAME ALUM

☐ D


LISTED SIZE + 1⅛" (29)
⅝" (16)
⅞" (22)
LISTED SIZE

USE WITH C & F
BORDERS ONLY
No. 2 FRAME STEEL

☐ B

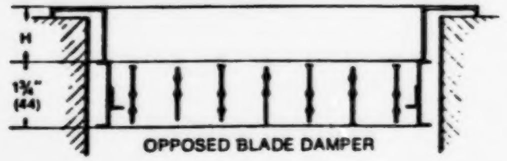
**NOTES & LIMITATIONS**

1. Type G concealed mounting is not recommended when grille length exceeds 48" (1219), or the grille area exceeds 720 square inches (0.465 square meters).
2. Type A or type C mounting is recommended for grilles that exceed the above limits.
3. Type G concealed fastening is not available on core styles 31 & 32.
4. Type SC concealed mounting, use only with border/mounting frame combinations C/K or NM/T.
5. Type SC concealed mounting not to be used for ceiling applications.

NOTE: ALL METRIC DIMENSIONS ( ) ARE SOFT CONVERSION. IMPERIAL DIMENSIONS ARE CONVERTED TO METRIC AND ROUNDED TO THE NEAREST MILLIMETER.

### VOLUME CONTROL

NONE ☐



OPPOSED BLADE DAMPER

H DIMENSION VARIES—SEE CORE STYLE DETAILS.

☒ 3

FOR MOUNTING FRAMES
D, K & T
REQUIRED OPENING IS
LISTED SIZE PLUS ¼" (6).

### SUBMITTED DETAILS

| D = LISTED SIZE | BORDER | CORE STYLE | LOUVER ORIENTATION | VOLUME CONTROLLER | MOUNTING FRAME | FASTENING | FINISH |
|---|---|---|---|---|---|---|---|
|  | F | 12 | L | 3 |  | A | B15 |

"L" - FRONT LOUVERS PARALLEL TO LONG DIMENSION.
"S" - FRONT LOUVERS PARALLEL TO SHORT DIMENSION.

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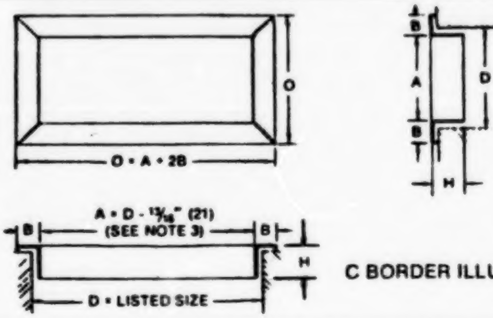
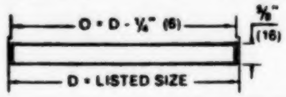
# Submittal Sheet

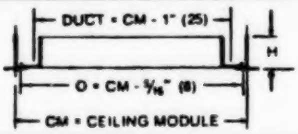
## RETURN GRILLES & REGISTERS



C BORDER ILLUSTRATED



CH BORDER



TB BORDER

### NOTES & LIMITATIONS

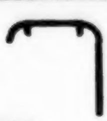
1. Reference Catalogue D-1, Grilles & Registers.
2. Nominal Opening equals listed size except where noted otherwise.
3. ED Border must be used with V Mounting Frame, for combination, A = D - 1 13/16" (46).
4. For B Dimensions, see Border Details.
5. For H Dimensions, see Core Style Details.
6. Louvre blades fixed.
7. Countersunk screw holes for No. 8 S.M.S. - per factory standard.
8. Factory tolerance ± 1/32" (1).

### FINISH

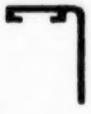
☒ B15 ALUMINUM BAKED ENAMEL
☐ B12 OFF-WHITE BAKED ENAMEL
☐ C1 ALUMINUM PRIME COAT, SUITABLE FOR FIELD PAINTING
☐ P1 PRE-TREATMENT FOR FIELD PAINTING (Aluminum Products Only).
☐ SPECIAL

VENDOR'S DOCUMENT REVIEW
☐ REVIEWED AS NOTED (AN)
☒ REVIEWED - NO COMMENTS (NC)
"REVIEW of this drawing does not relieve supplier from full compliance with contract or purchase order requirements."
By J.E.H. Kilborn Date 22/12/16

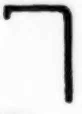
### 1 BORDERS



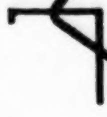
CURVED FACE ALUMINUM
B = 1 1/4" (32) ☒ C



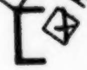
NARROW MARGIN ALUMINUM
B = 1" (25) ☐ NM



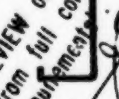
EXPOSED DUCT ALUMINUM (SEE NOTE 3)
B = 13/16" (21) ☐ ED



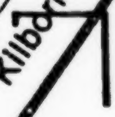
FLAT FACE ALUMINUM
B = 1 1/4" (32) ☐ F



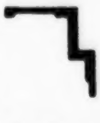
CHANNEL (No 80 CORE) ALUMINUM
B = 5/16" (8) ☐ CH



FLAT FACE FOR T-BAR ALUMINUM
B = 3/4" (19) ☐ TB



FLAT FACE HEAVY DUTY STEEL
B = 1 1/4" (32) ☐ GG

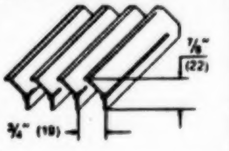


FLAT FACE HEAVY DUTY ALUMINUM
B = 1 1/4" (32) ☐ GH

NOTE ALL METRIC DIMENSIONS ( ) ARE SOFT CONVERSION IMPERIAL DIMENSIONS ARE CONVERTED TO METRIC AND ROUNDED TO THE NEAREST MILLIMETER

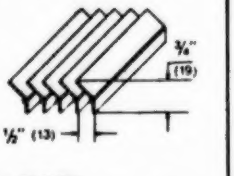
### 2 CORE STYLES

ALUM 45° DEFL



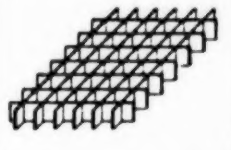
H = 1 5/16" (33)
ALL BORDERS EXCEPT — CH GG & GH ☐ 60

ALUM 45° DEFL



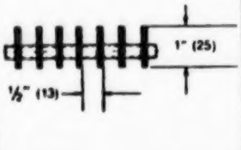
H = 1 5/16" (33)
ALL BORDERS EXCEPT — CH GG & GH ☐ 70

1/2" x 1/2" x 1/2" (13) ALUM GRID 0° DEFL



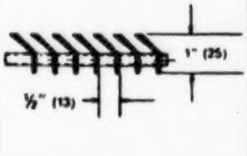
H = 1 1/16" (27)
ALL BORDERS EXCEPT — GG & GH ☒ 80

ALUM 0° DEFL.



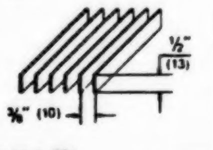
H = 2" (51)
USE WITH GH BORDER ONLY ☐ 97

ALUM 45° DEFL.



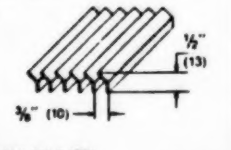
H = 2" (51)
USE WITH GH BORDER ONLY ☐ 98

14 GA HEAVY DUTY STEEL 0° DEFL.



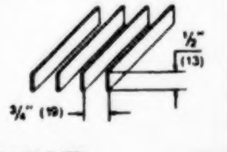
H = 1 1/16" (27)
USE WITH GG BORDER ONLY ☐ 90

14 GA HEAVY DUTY STEEL 45° DEFL



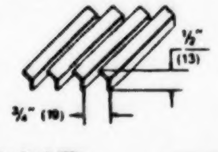
H = 1 1/16" (27)
USE WITH GG BORDER ONLY ☐ 91

14 GA HEAVY DUTY STEEL 0° DEFL



H = 1 1/16" (27)
USE WITH GG BORDER ONLY ☐ 95

14 GA HEAVY DUTY STEEL 45° DEFL



H = 1 1/16" (27)
USE WITH GG BORDER ONLY ☐ 96

FOR FILTER GRILLE DETAILS, SEE REVERSE SIDE.

**PROJECT** DEVON COAL RESEARCH
FIELD MAINT. BLDG

**ENGINEER** KILBORN

**CUSTOMER** GEN AIR.

**SUBMITTAL DATE**

**SPEC. SYMBOL** E-1

**e.h.price LIMITED**

203509

Oct./86

RETURN GRILLES & REGISTER

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**e.h.price LIMITED**

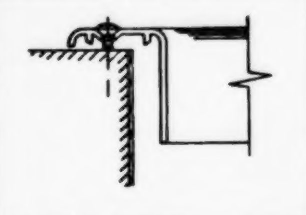
# Submittal Sheet

## OPTIONS & ACCESSORIES FOR RETURN GRILLES & REGISTERS

### FASTENING

NONE ☐ –

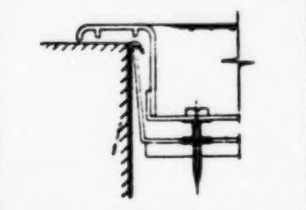
### SCREW MOUNTING



USE WITH ALL BORDERS
EXCEPT – CH, FF & TB

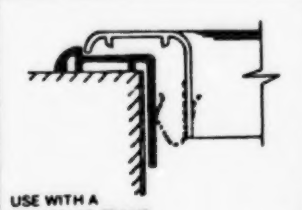
☒ A

### CONCEALED MOUNTING



USE WITH ALL BORDERS
EXCEPT – CH, TB, GH & FF

☐ C

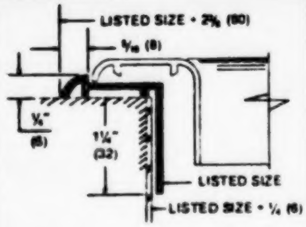


USE WITH A
MOUNTING FRAME
SEE LIMITATION
NOTES 1 & 2

☐ SC

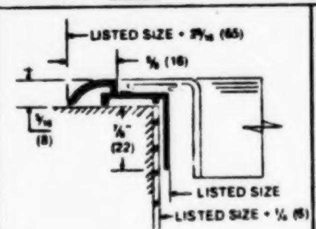
### MOUNTING FRAMES

NONE ☐ –


LISTED SIZE + 2⅜ (60)
5/16 (8)
¼" (6)
1¼" (32)
LISTED SIZE
LISTED SIZE + ¼ (6)

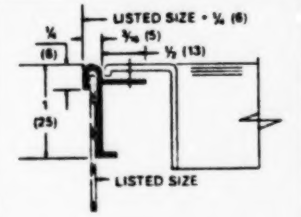
USE WITH C
BORDER ONLY
No. 316 FRAME ALUM

☐ K


LISTED SIZE + 2 9/16 (65)
⅝ (16)
5/16 (8)
⅞" (22)
LISTED SIZE
LISTED SIZE + ¼ (6)

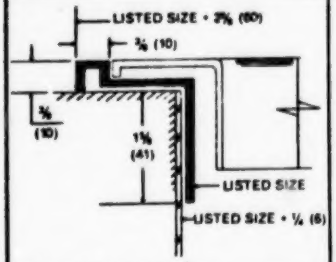
USE WITH NM
BORDER ONLY
No 863 FRAME ALUM

☐ T


LISTED SIZE + ¼ (6)
¼ (6)
3/16 (5)
½ (13)
1 (25)
LISTED SIZE

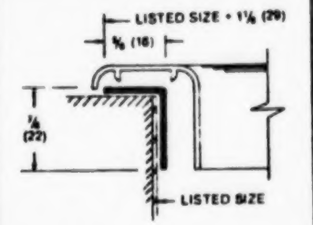
USE WITH ED
BORDER ONLY
No 884 FRAME ALUM

☐ V


LISTED SIZE + 2⅜ (60)
⅜ (10)
⅜ (10)
1⅝ (41)
LISTED SIZE
LISTED SIZE + ¼ (6)

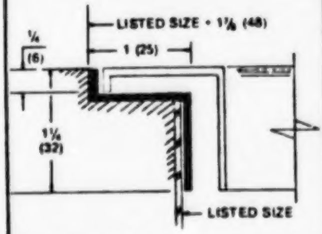
USE WITH F BORDER ONLY
NO. 115 FRAME ALUM

☐ D


LISTED SIZE + 1⅛ (29)
⅝ (16)
⅞ (22)
LISTED SIZE

USE WITH C & F
BORDERS ONLY
No. 2 FRAME STEEL

☐ B

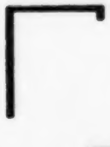

LISTED SIZE + 1⅞ (48)
¼ (6)
1 (25)
1¼ (32)
LISTED SIZE

USE WITH F & GG
BORDERS ONLY
No 3 FRAME STEEL

☐ C

### FILTER GRILLES

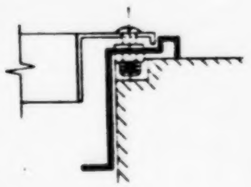
**Border**



FLAT FACE
ALUMINUM
B = 1¼" (32)

☐ FF

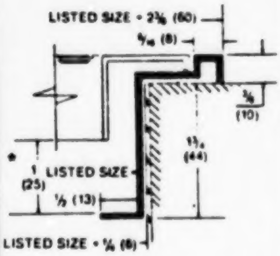
**Quick Release Fastener**



FOR FF BORDER
AND G MOUNTING
FRAME ONLY

☐ Q

**Mounting Frame**


LISTED SIZE + 2⅜ (60)
5/16 (8)
⅜ (10)
1¾ (44)
*
1 (25)
LISTED SIZE
½ (13)
LISTED SIZE + ¼ (6)

* SPACE 1" (25)
FOR FILTER BY OTHERS

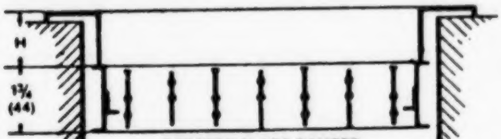
USE WITH FF
BORDER ONLY
FILTER FRAME ALUM

☐ G

Filter grilles will be hinged if grille size is 36" x 24" (914 x 610) or less. Otherwise, quick release fasteners will be supplied all around. Volume control dampers for use with filter grilles, to be ordered as separate items for duct mounted installation.

### VOLUME CONTROL

NONE ☐ –



OPPOSED BLADE DAMPER

(NOT APPLICABLE FOR CH BORDERS
USE TB AS ALTERNATE FRAME)

H DIMENSION VARIES – SEE CORE STYLE DETAILS

☒ 3

FOR MOUNTING FRAMES
D, G, K & T
REQUIRED OPENING IS
LISTED SIZE PLUS ¼" (6)

### LIMITATION NOTES

1. Type SC concealed mounting, use only with border/mounting frame combinations C/K, NM/T or F/D.
2. Type SC concealed mounting not to be used for ceiling applications.

NOTE: ALL METRIC DIMENSIONS ( ) ARE SOFT CONVERSION. IMPERIAL DIMENSIONS ARE CONVERTED TO METRIC AND ROUNDED TO THE NEAREST MILLIMETER

### SUBMITTED DETAILS

| D = LISTED SIZE | BORDER | CORE STYLE | LOUVER ORIENTATION | VOLUME CONTROLLER | MOUNTING FRAME | FASTENING | FINISH |
|---|---|---|---|---|---|---|---|
|  | C | 80 |  | 3 |  | A | B15 |

"L" - FRONT LOUVERS PARALLEL TO LONG DIMENSION
"S" - FRONT LOUVERS PARALLEL TO SHORT DIMENSION

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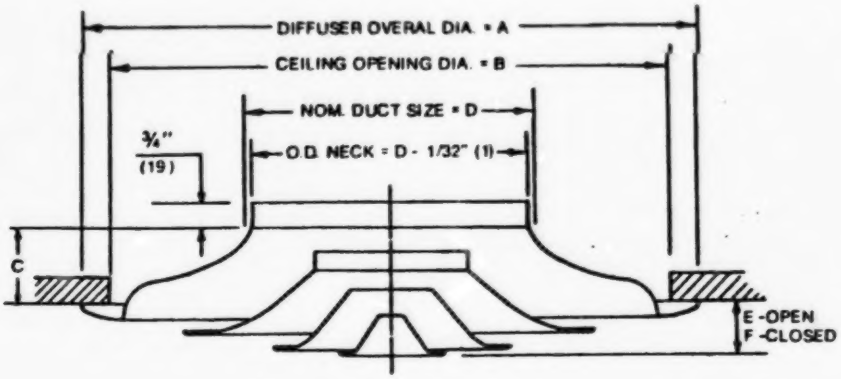
# Submittal Sheet



## MODEL RCD, RCDA, RCDA1
## ADJUSTABLE AIR PATTERN
## ROUND CEILING DIFFUSERS

**SI UNITS (mm)**

| Nom. Size | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 6 | 343 | 305 | 41 | 152 | 37 | 16 |
| 8 | 457 | 406 | 54 | 203 | 45 | 19 |
| 10 | 572 | 508 | 67 | 254 | 54 | 22 |
| 12 | 686 | 610 | 83 | 305 | 64 | 25 |
| 14 | 800 | 711 | 95 | 356 | 79 | 30 |
| 16 | 914 | 813 | 108 | 406 | 84 | 33 |
| 18 | 1029 | 914 | 124 | 457 | 95 | 38 |
| 20 | 1143 | 1016 | 137 | 508 | 105 | 41 |
| 24 | 1372 | 1219 | 165 | 610 | 124 | 48 |
| 30 | 1715 | 1524 | 203 | 762 | 141 | 48 |
| 36 | 1715 | 1524 | 203 | 914 | 141 | 48 |

**IMPERIAL UNITS (inches)**

| Nom. Size | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 6 | 13½ | 12 | 1⅝ | 6 | 1⁷⁄₁₆ | ⅝ |
| 8 | 18 | 16 | 2⅛ | 8 | 1¾ | ¾ |
| 10 | 22½ | 20 | 2⅝ | 10 | 2⅛ | ⅞ |
| 12 | 27 | 24 | 3¼ | 12 | 2½ | 1 |
| 14 | 31½ | 28 | 3¾ | 14 | 3⅛ | 1³⁄₁₆ |
| 16 | 36 | 32 | 4¼ | 16 | 3⁵⁄₁₆ | 1⁵⁄₁₆ |
| 18 | 40½ | 36 | 4⅞ | 18 | 3¾ | 1½ |
| 20 | 45 | 40 | 5⅜ | 20 | 4⅛ | 1⅝ |
| 24 | 54 | 48 | 6½ | 24 | 4⅞ | 1⅞ |
| 30 | 67½ | 60 | 8 | 30 | 5⁹⁄₁₆ | 1⅞ |
| 36 | 67½ | 60 | 8 | 36 | 5⁹⁄₁₆ | 1⅞ |

**MODEL SUBMITTED**

☐ RCD
☒ RCDA
☐ RCDA1

**FINISH:**

☐ B13 Off-white baked enamel.
☒ B15 Aluminum baked enamel.
☐ PC15 Aluminum prime coat, suitable for field painting.

**MATERIAL:**

Heavy gauge steel.

Factory tolerance: ± 1/32" (1)

Reference
Catalogue C-1

ALL METRIC DIMENSIONS ( ) ARE SOFT CONVERSION. IMPERIAL DIMENSIONS ARE CONVERTED TO METRIC AND ROUNDED TO THE NEAREST MILLIMETER

| | | |
|---|---|---|
| **PROJECT:** DEVON COAL RESEARCH<br>FIELD MAINT. BLDG | | e.h.price LIMITED |
| **NGINEER:** KILBORN | | **RCD, RCDA, RCDA1**<br>ROUND CEILING DIFFUSERS |
| **CUSTOMER:** GEN AIR | 210473 | |
| **SUBMITTAL DATE:** | **SPEC. SYMBOL:** S2 & 3 | OCT/86 |

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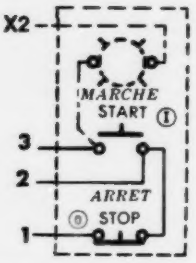
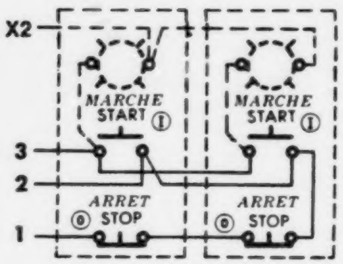
PRINTED IN CANADA

8.2A W 50

| WIRING OF PILOT CONTROL DEVICES TO NON-REVERSIBLE STARTERS | | No | *CONNEXIONS DES DISPOSITIFS DE COMMANDE AUX DEMARREURS NON INVERSEURS* | |
|---|---|---|---|---|
| **PUSH BUTTON** | START, STOP<br>Two START, STOP<br>Illuminated START, STOP<br>Maintained START, STOP | 1<br>2<br>3<br>4 | *MARCHE, ARRET*<br>*Deux MARCHE, ARRET*<br>*MARCHE lumineux, ARRET*<br>*MARCHE, ARRET à contact maintenu* | ***BOUTON-POUSSOIR*** |
| **PILOT LIGHT** | OFF<br>PUSH-TO-TEST | 5<br>6 | *HORS CIRCUIT (Hors Service)*<br>*AVEC BOUTON D'ESSAI* | ***LAMPE-TEMOIN*** |
| **SELECTOR SWITCH** | HAND-OFF-AUTO<br>OFF-ON | 7, 8<br>9, 10 | *MANUEL-ARRET-AUTOMATIQUE*<br>*HORS-EN* | ***SELECTEUR*** |
| AUTOMATIC CONTROL SWITCH only (2 wire) | | 11 | *INTERRUPTEUR DE COMMANDE seulement (2 fils)* | |

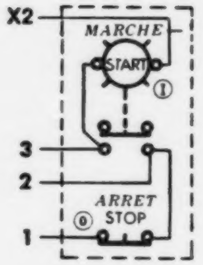

X2
MARCHE
START
3
2
ARRET
STOP
1

No 1

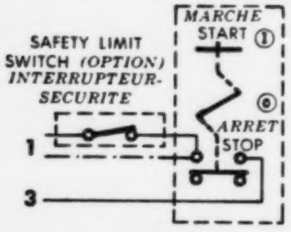

X2
MARCHE
START
MARCHE
START
3
2
ARRET
STOP
ARRET
STOP
1

No 2

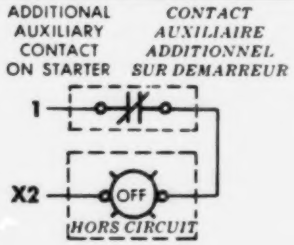
8L


X2
MARCHE
START
3
2
ARRET
STOP
1

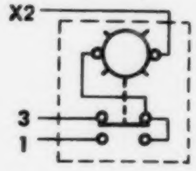
No 3


MARCHE
START
SAFETY LIMIT
SWITCH (OPTION)
INTERRUPTEUR-
SECURITE
ARRET
STOP
1
3

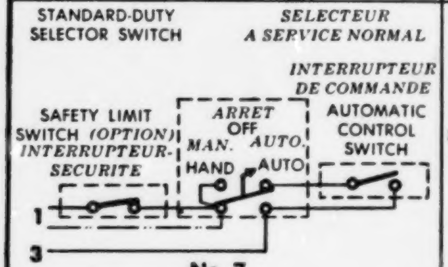
No 4


ADDITIONAL
AUXILIARY
CONTACT
ON STARTER
CONTACT
AUXILIAIRE
ADDITIONNEL
SUR DEMARREUR
1
X2
OFF
HORS CIRCUIT

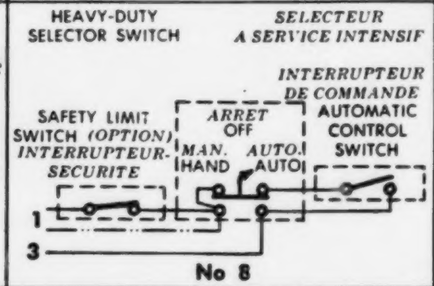
No 5



No 6

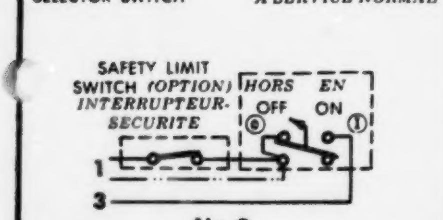

STANDARD-DUTY
SELECTOR SWITCH
SELECTEUR
A SERVICE NORMAL
INTERRUPTEUR
DE COMMANDE
SAFETY LIMIT
SWITCH (OPTION)
INTERRUPTEUR-
SECURITE
ARRET
OFF
MAN.
AUTO.
HAND
AUTO
AUTOMATIC
CONTROL
SWITCH
1
3

No 7

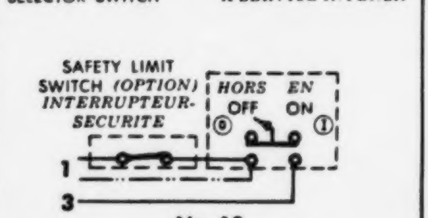

HEAVY-DUTY
SELECTOR SWITCH
SELECTEUR
A SERVICE INTENSIF
INTERRUPTEUR
DE COMMANDE
SAFETY LIMIT
SWITCH (OPTION)
INTERRUPTEUR-
SECURITE
ARRET
OFF
MAN.
AUTO.
HAND
AUTO
AUTOMATIC
CONTROL
SWITCH
1
3

No 8

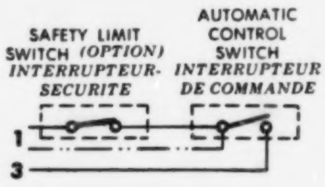
**ALLEN-BRADLEY**


STANDARD-DUTY
SELECTOR SWITCH
SELECTEUR
A SERVICE NORMAL
SAFETY LIMIT
SWITCH (OPTION)
INTERRUPTEUR-
SECURITE
HORS
OFF
EN
ON
1
3

No 9

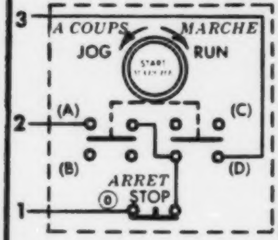

HEAVY-DUTY
SELECTOR SWITCH
SELECTEUR
A SERVICE INTENSIF
SAFETY LIMIT
SWITCH (OPTION)
INTERRUPTEUR-
SECURITE
HORS
OFF
EN
ON
1
3

No 10


SAFETY LIMIT
SWITCH (OPTION)
INTERRUPTEUR-
SECURITE
AUTOMATIC
CONTROL
SWITCH
INTERRUPTEUR
DE COMMANDE
1
3

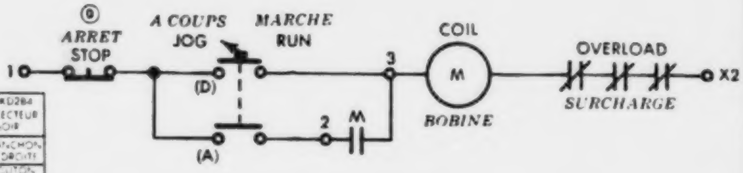
No 11

| **WIRING OF PILOT CONTROL DEVICES TO NON-REVERSIBLE STARTERS** | | | *CONNEXIONS DES DISPOSITIFS DE COMMANDE AUX DEMARREURS NON INVERSEURS* | |
|---|---|---|---|---|
| | | No | | |
| **JOGGING** | JOG-RUN, STOP<br>START, JOG-RUN, STOP<br>Two START, JOG, STOP with jog relay. | 12<br>13<br>14 | *A-COUPS - MARCHE, ARRET*<br>*MARCHE, A-COUPS - MARCHE, ARRET*<br>*Deux MARCHE, A-COUPS, ARRET avec relais à-coups.* | ***PAR A-COUPS*** |

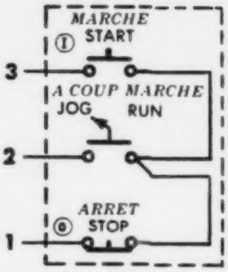

3
A COUPS
MARCHE
JOG
RUN
START
(A)
(C)
2
(B)
(D)
ARRET
STOP
1

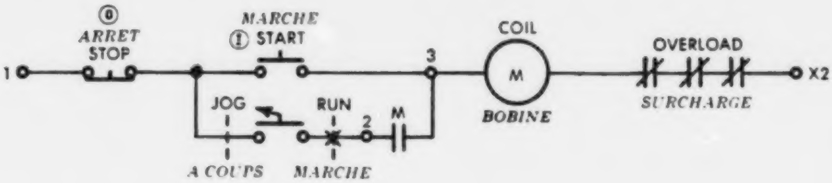
| BULLETIN 800T TYPE KD2B4 JOG-RUN SELECTOR SWITCH PUSHBUTTON | | | | |
|---|---|---|---|---|
| CONTACTS | SLEEVE TO LEFT | | SLEEVE TO RIGHT | |
| | BUTTON | | BUTTON | |
| | FREE | PRESS | FREE | PRESS |
| 1A | | | x | x |
| 1B | | x | | |
| 1C | | | x | |
| 1D | | x | | x |

| BULLETIN 800T TYPE KD2B4 A COUPS-MARCHE SELECTEUR ET BOUTON POUSSOIR | | | | |
|---|---|---|---|---|
| CONTACTS | MANCHON A GAUCHE | | MANCHON A DROITE | |
| | BOUTON | | BOUTON | |
| | [illegible] | [illegible] | [illegible] | [illegible] |
| 1A | | | x | x |
| 1B | | x | | |
| 1C | | | x | |
| 1D | | x | | x |

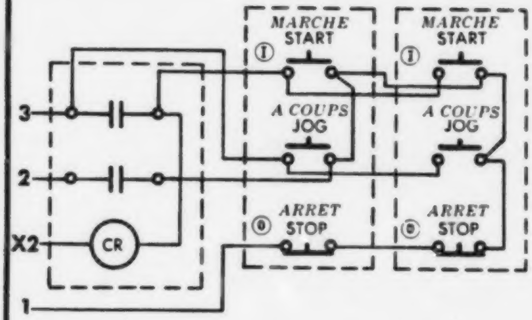

ARRET
STOP
A COUPS
JOG
MARCHE
RUN
COIL
OVERLOAD
1
(D)
3
M
X2
SURCHARGE
2
M
BOBINE
(A)

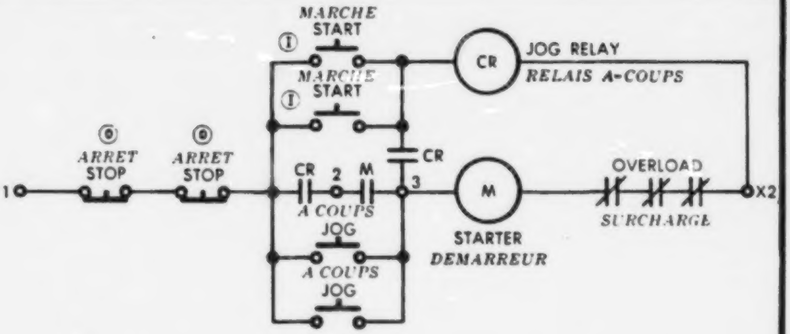
No 12


MARCHE
START
3
A COUP
MARCHE
JOG
RUN
2
ARRET
STOP
1


ARRET
STOP
MARCHE
START
3
COIL
OVERLOAD
1
M
X2
JOG
RUN
2
M
BOBINE
SURCHARGE
A COUPS
MARCHE

No 13

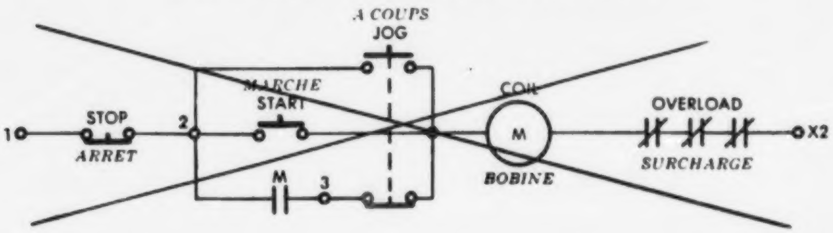

MARCHE
START
MARCHE
START
A COUPS
JOG
A COUPS
JOG
3
2
X2
CR
ARRET
STOP
ARRET
STOP
1


MARCHE
START
CR
JOG RELAY
RELAIS A-COUPS
MARCHE
START
ARRET
STOP
ARRET
STOP
CR
CR
2
M
3
M
OVERLOAD
1
X2
A COUPS
JOG
STARTER
DEMARREUR
SURCHARGE
A COUPS
JOG

No 14

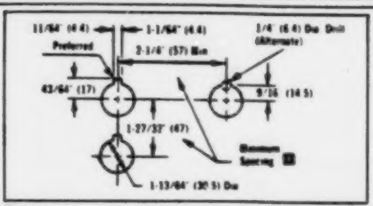
## "DO NOT USE THIS CIRCUIT"

## *NE JAMAIS EMPLOYER CE CIRCUIT*


A COUPS
JOG
MARCHE
START
COIL
OVERLOAD
1
STOP
ARRET
2
M
X2
M
3
BOBINE
SURCHARGE

# BULLETIN 800T INSTALLATION AND MOUNTING INSTRUCTIONS for Selector Switches

**CAUTION**: When any of these devices are installed in a metal enclosure 1/2" (12.5 mm) must be maintained between it and live metal parts of the contact block.


11/64" (4.4)
1-1/64" (4.4)
Preferred
1/4" (6.4) Dia. Drill (Alternate)
2-1/4" (57) Min
43/64" (17)
9/16" (14.5)
1-27/32" (47)
Minimum Spacing ■
1-13/64" (30.5) Dia

■ 2 and 3 position selector switches with wing lever requires 3" (76) minimum vertical spacing and 3 1/4" (82.5) minimum horizontal spacing.
Four position selector switch with wing lever requires 4" (101.5) minimum horizontal spacing and selector switches with knob levers require 2 1/2" (63.5) minimum horizontal spacing.

## Dimensional Data & Gasket Selection

| Panel Thickness | | | Gaskets |
|---|---|---|---|
| GA | INS | MM | |
| 16 | 1/16 | 1.6 | 3 |
| 12 | 7/64 | 2.8 | 2 |
| 10 | 9/64 | 3.6 | |
| — | 3/16 | 4.8 | 1 |
| Panels thicker than 3/16" must be counterbored | | | |

### Installation

1. Remove all parts above the gaskets.
   N.B. 3 gaskets provided as standard.
2. Select quantity of gaskets required.
3. Place unit with gaskets through mounting hole.
4. Fit legend plate or trim washer, thrust washer and mounting ring.
5. Tighten octagonal mounting ring.
6. The knob assembly or coin slot may be installed having any one of four orientations with repect to switch body. To obtain proper orientation determine the switch setting. (Position of the stop projection on the shaft with respect to the opening in the bushing, see ill. 3). Loosen mounting ring and arrange knob or coin slot indicator to point to the position on the legend plate which corresponds to the switch setting. Tighten mounting ring.

### Modification for Horizontal Mounting

The cylinder lock selector switch devices are factory assembled for vertical mounting. They may be modified for horizontal mounting in the following manner (see ill 4). **First remove key from lock**. Remove the two flat-head screws and lift the mounting bushing straight off the base. Do not twist. **IMPORTANT: Do not** rotate any parts within either the base assembly or the mounting bushing while these two sub-assemblies are separate from each other, as this can cause incorrect switch operation after reassembly. While separated from the base, turn the mounting bushing counter-clockwise 90° and reassemble the unit. Note: On the four position selector switches, turn the mounting bushing **clockwise** 90° and reassemble. In the proper position a pin on the mounting bushing will engage a hole in the base and the originally-used mounting screw holes will be aligned with tapped holes in the base. Reassemble and tighten the two flat-head screws. Check the switch for proper operation and correct contact action.

### Keying

Knob assemblies having 3 legs may be keyed to interfere with assembly of the knob except in the selected position. If keying is desired, determine which of the four holes in the shaft will not be occupied by one of the 3 legs of the knob assembly or coin slot cap when the knob or cap is properly oriented. Fill the unused hole with a rigid material. (A No. 8 x 1/4" (6.4) long set screw or other similarly sized "plug" may be used, apply light pressure only).

Knob assemblies having only 2 legs may be partially keyed. (When keyed, a 2-leg knob will fit in either of 2 positions, 180° apart.) If such keying is desired fill either of the two unoccupied holes in the shaft according to the instructions above.

Thread mounting ring onto bushing with knob assembly or coin slot cap in place, and tighten securely.

### Grounding

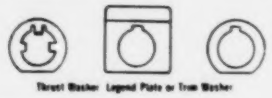
As required. See illustration 5.
A device bonding kit, Cat. No. 800T-N300, is available to meet the bonding requirements of CSA Standard C22.2 No. 0.4.

### Contact Blocks

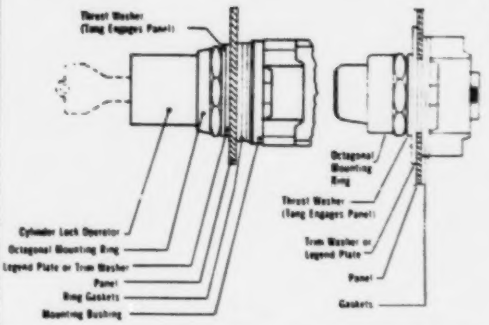
An operator may be used with one to four of Catalog Numbers 800T-XD1, -XD2, -XD3, -XD4, -XA, -XA1, -XA2, -XA4 or -XA7 contact blocks (Series "C" or higher), one to four of Catalog Numbers 800T-XD1R, -XD2R, XAR, -XA2R or -XA4R logic reed contact blocks (Series "A" or higher). Catalog Numbers 800T-XD5 or -XD6 (Series "B" or higher) may be used on second level only. The contact blocks may be mounted in tandem, two tiers high maximum.

Sealed contact switch blocks, Catalog Numbers 800T-XAP, -XD1P and -XD2P, may be mounted singly or side-by-side, directly to an operator (no stacking).

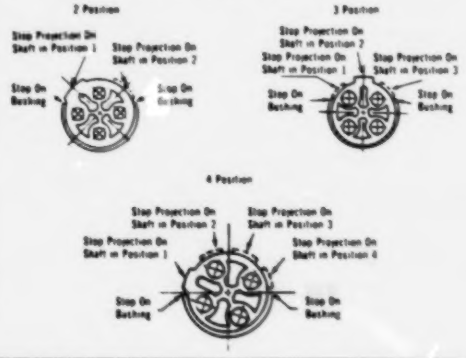
### Illustration 1 Common Parts


Thrust Washer
Legend Plate or Trim Washer

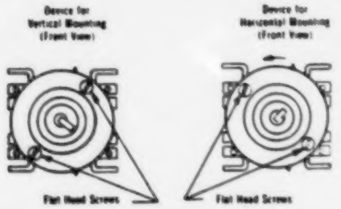
### Illustration 2


Thrust Washer (Tang Engages Panel)
Cylinder Lock Operator
Octagonal Mounting Ring
Legend Plate or Trim Washer
Panel
Ring Gaskets
Mounting Bushing
Octagonal Mounting Ring
Thrust Washer (Tang Engages Panel)
Trim Washer or Legend Plate
Panel
Gaskets

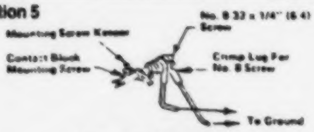
### Illustration 3 Shaft & Bushing Assembly


2 Position
Stop Projection On Shaft in Position 1
Stop Projection On Shaft in Position 2
Stop On Bushing
Stop On Bushing
3 Position
Stop Projection On Shaft in Position 2
Stop Projection On Shaft in Position 1
Stop Projection On Shaft in Position 3
Stop On Bushing
Stop On Bushing
4 Position
Stop Projection On Shaft in Position 2
Stop Projection On Shaft in Position 3
Stop Projection On Shaft in Position 1
Stop Projection On Shaft in Position 4
Stop On Bushing
Stop On Bushing

### Illustration 4


Device for Vertical Mounting (Front View)
Device for Horizontal Mounting (Front View)
Flat Head Screws
Flat Head Screws

### Illustration 5


No. 8-32 x 1/4" (6.4) Screw
Mounting Screw Keeper
Contact Block Mounting Screw
Crimp Lug For No. 8 Screw
To Ground

Grounding Method When Required

## INSTRUCTIONS FOR INSTALLATION OF CONDUIT AND GROUNDING OF EQUIPMENT IN NON-METALLIC ENCLOSURES

1. CONDUIT HOLES

   These can be cut with a Greenlee Cutter or a hole saw. The Greenlee Cutter i the better method; the punch should be drawn from the inside of th Enclosure to the outside.

2. CONDUIT CONNECTIONS

   a. Metallic Conduit

      Fit the Conduit connector to the Conduit. Fit the connector and Conduit to the enclosure and tighten the locknut. Attach a grounding bushing over the locknut.
      The grounding bushing lug must be correctly sized for the ground wire.

   b. Non-Metallic Conduit

      Fit the Conduit connector to either the Conduit or the enclosure. Fit locknut. No grounding bushing needed.

**IMPORTANT**

**Any unnecessary stress caused by bad alignment of the Conduit may damage the enclosure walls.**
**Maximum corrosion protection is obtained by sealing off conduit openings where conductors enter the enclosure and applying a suitable coating to all exposed metal.**

3. GROUNDING OF EQUIPMENT

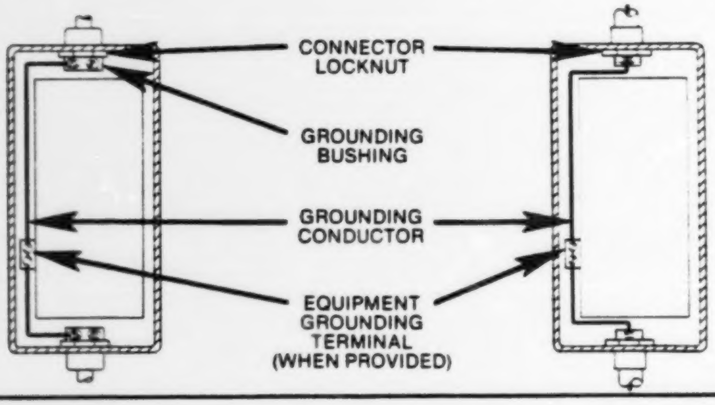
   Bonding between grounding bushings or grounding bushings and the equip ment grounding terminal should be made as shown in the diagram below.

**IMPORTANT**

**Connections must be made in accordance with the requirements of the Canadia Electrical Code.**

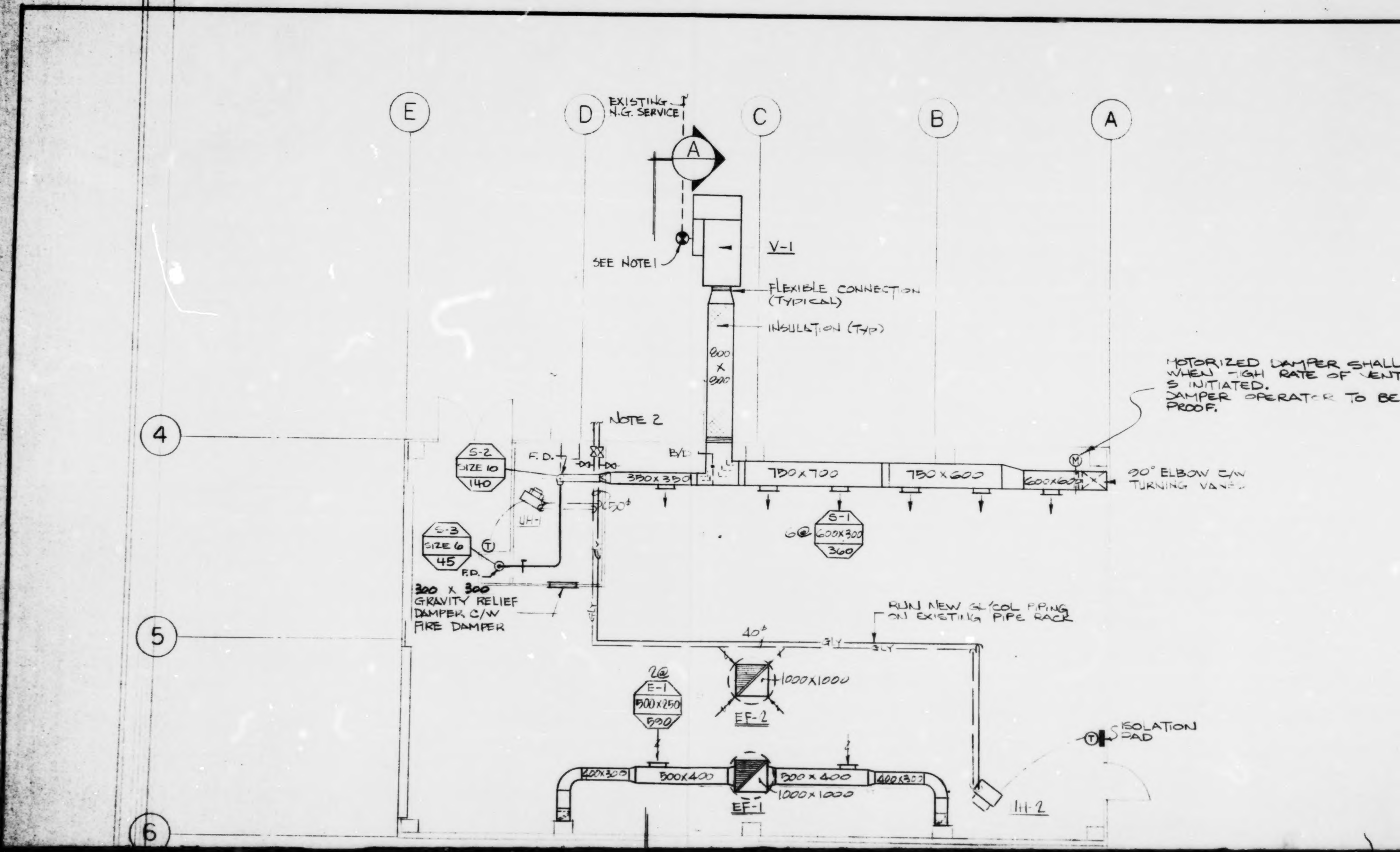
**GROUNDING INSTRUCTIONS**

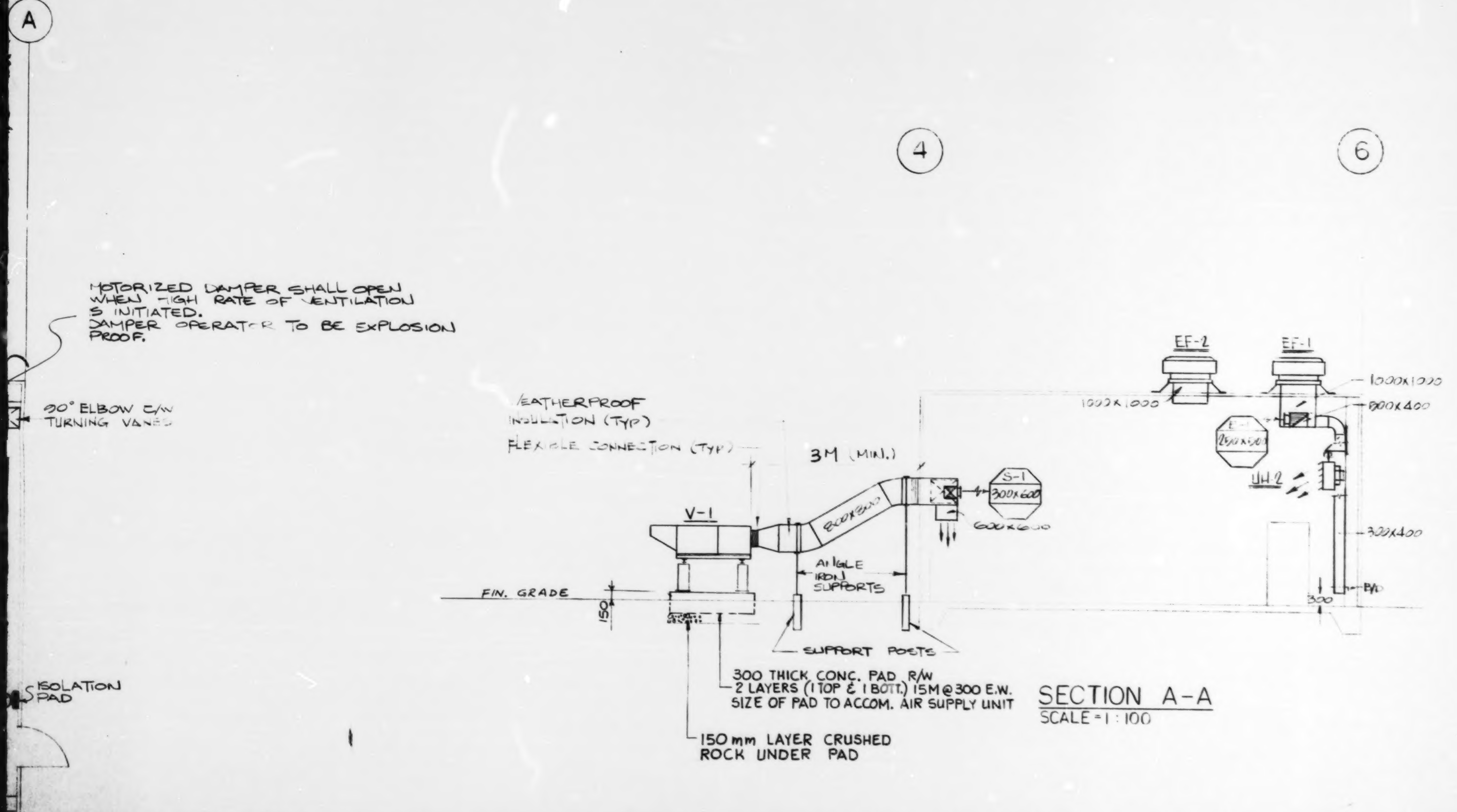
**METALLIC CONDUIT** **NON-METALLIC CONDUIT**



FORM C709-209A

ALLEN-BRADLE

E
D
C
B
A
EXISTING
N.G. SERVICE
A
V-1
SEE NOTE 1
FLEXIBLE CONNECTION
(TYPICAL)
INSULATION (TYP)
800
x
800
MOTORIZED DAMPER SHALL
WHEN HIGH RATE OF VENT
S INITIATED.
DAMPER OPERATOR TO BE
PROOF.
4
NOTE 2
F. D.
B/D
S-2
SIZE 10
140
350x350
750x700
750x600
600x600
M
90° ELBOW C/W
TURNING VANES
UH-1
50φ
S-3
SIZE 6
45
T
F.D.
6@
S-1
600x300
360
300 x 300
GRAVITY RELIEF
DAMPER C/W
FIRE DAMPER
RUN NEW GLYCOL PIPING
ON EXISTING PIPE RACK
5
40φ
GLY
GLY
GLY
2@
E-1
500x250
590
1000x1000
EF-2
T
ISOLATION
PAD
400x300
500x400
500 x 400
400x300
1000x1000
EF-1
UH-2
6


A
4
6
EF-2
EF-1
1000x1000
1000x1000
800x400
E-1
2500x500
UH-2
300x400
B/D
300
S-1
300x600
600x600
3M (MIN.)
800x800
V-1
FIN. GRADE
150

MOTORIZED DAMPER SHALL OPEN WHEN HIGH RATE OF VENTILATION IS INITIATED.
DAMPER OPERATOR TO BE EXPLOSION PROOF.

90° ELBOW C/W TURNING VANES

WEATHERPROOF INSULATION (TYP)

FLEXIBLE CONNECTION (TYP)

ANGLE IRON SUPPORTS

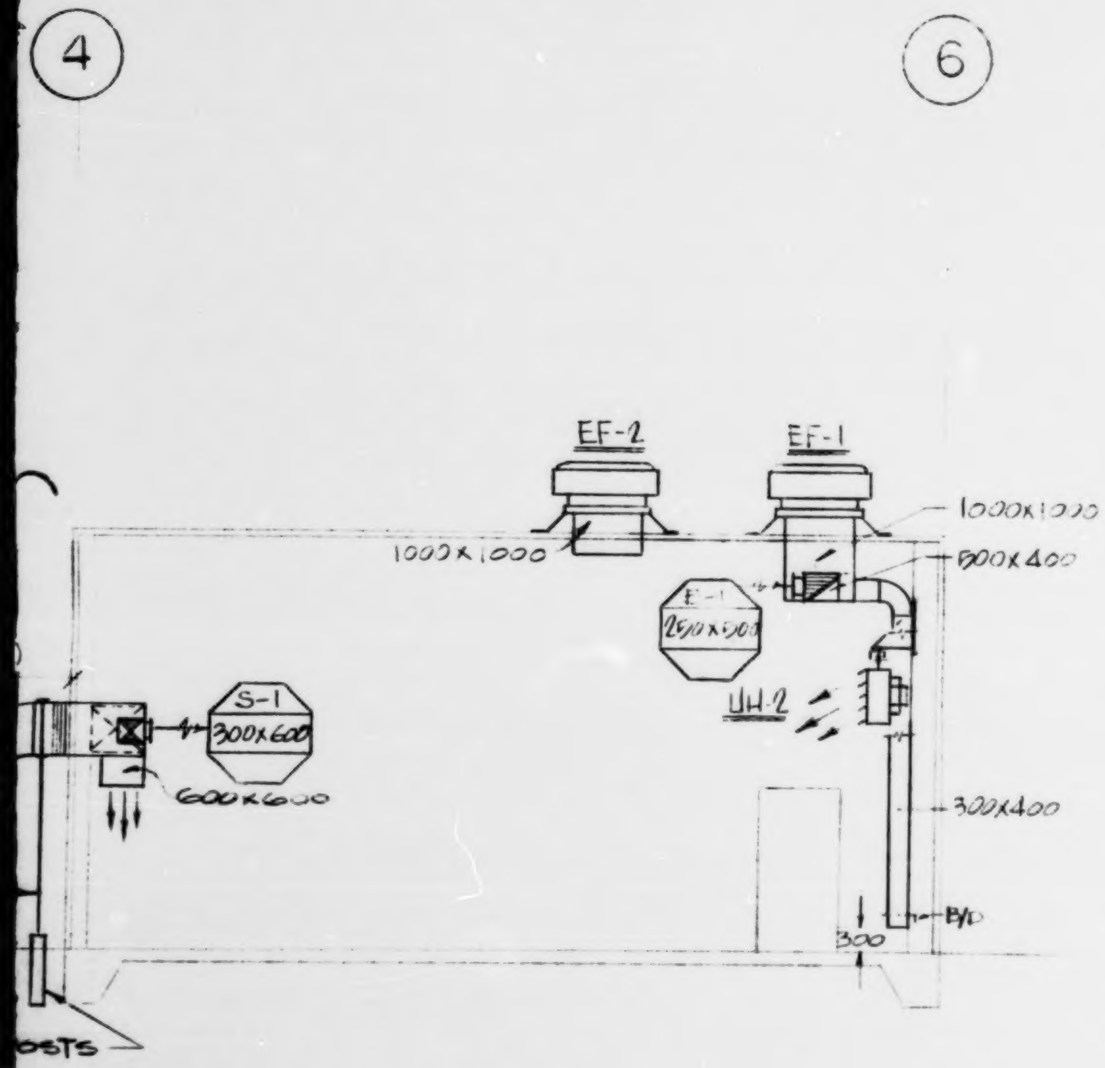
SUPPORT POSTS

300 THICK CONC. PAD R/W
2 LAYERS (1 TOP & 1 BOTT.) 15M @ 300 E.W.
SIZE OF PAD TO ACCOM. AIR SUPPLY UNIT

150 mm LAYER CRUSHED ROCK UNDER PAD

ISOLATION PAD

SECTION A-A
SCALE = 1 : 100


4
6
EF-2
EF-1
1000x1000
1000x1000
800x400
E-1
2500x500
UH-2
S-1
300x600
600x600
300x400
B/D
300
OSTS
R/W
T.) 15M @ 300 E.W.
AIR SUPPLY UNIT

SECTION A-A
SCALE = 1 : 100

**Alberta**
PUBLIC WORKS,
SUPPLY AND SERVICES
Property Planning Division

A.P.W.S.S. USE ONLY

KILBORN

PROJECT NO. A149-15

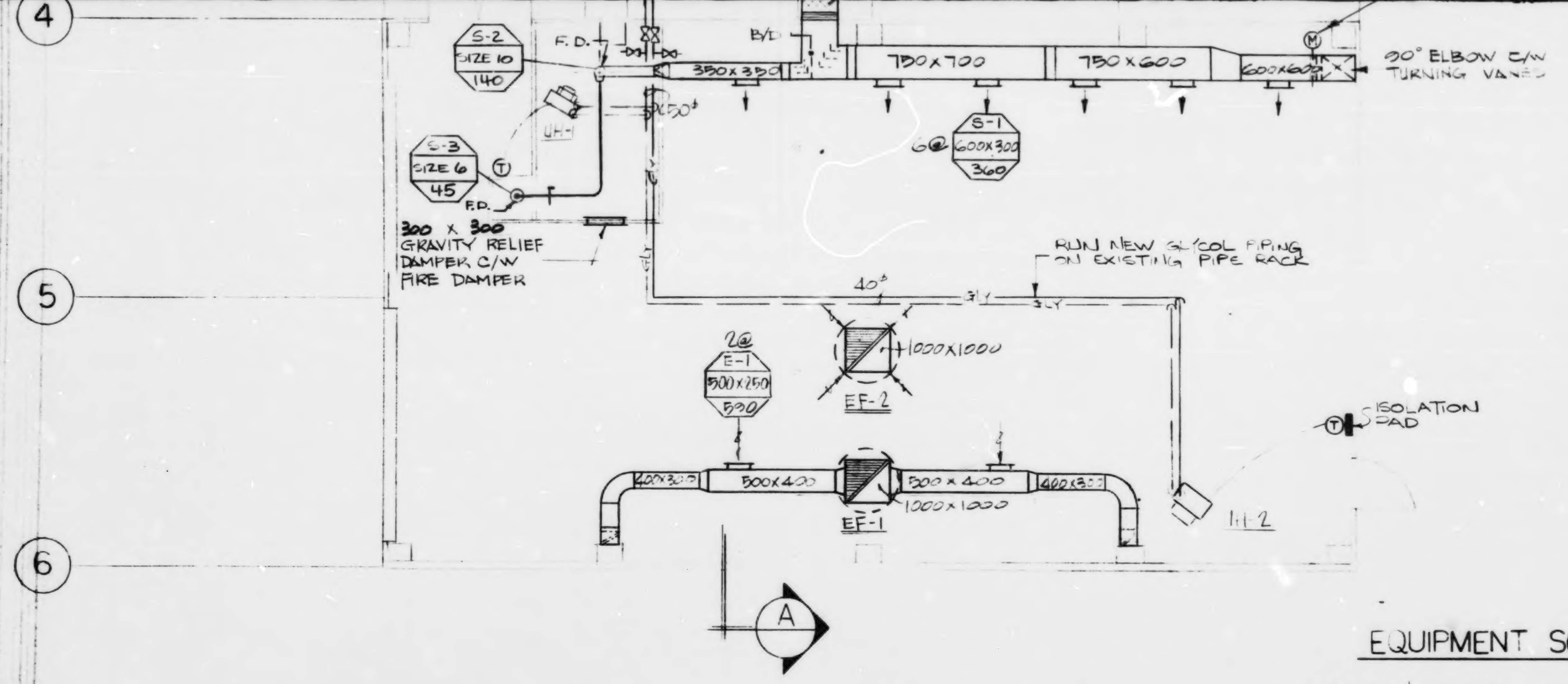
8710 19

PERMIT TO PRACTISE
KILBORN
Signature
Date Oct 23, 1987
PERMIT NUMBER: P 4336
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

**NOTES:** DO NOT SCALE FROM DRAWINGS. REFER TO CEILING AND WINDOW MULLIONS IN RELATION TO PARTITIONS.

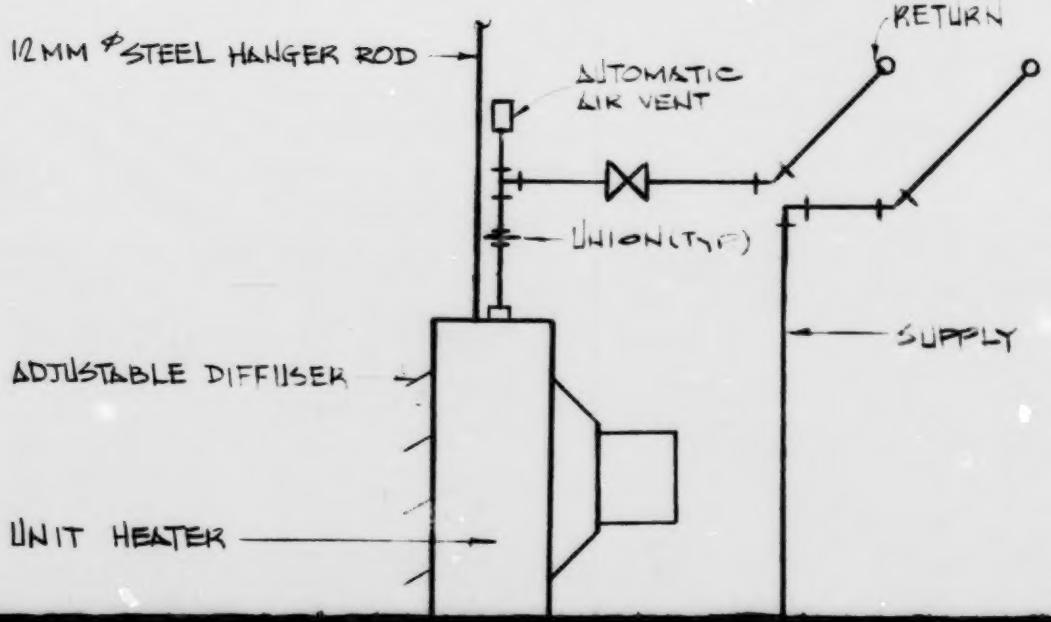
CONTRACTOR MUST VERIFY ALL DIMENSIONS; IN CASE OF ERRORS OR DISCREPANCIES ALBERTA PUBLIC WORKS, SUPPLY AND SERVICES MUST BE NOTIFIED.

| | | |
|---|---|---|
| DESIGNER | | DATE: |


4
5
6
S-2
SIZE 10
140
F.D.
B/D
350x350
750x700
750x600
600x600
M
90° ELBOW C/W
TURNING VANE
S-1
6@ 600x300
360
S-3
SIZE 6
45
T
F.D.
UH-1
50φ
GLY
300 x 300
GRAVITY RELIEF
DAMPER C/W
FIRE DAMPER
RUN NEW GLYCOL PIPING
ON EXISTING PIPE RACK
40φ
GLY
2@
E-1
500x250
590
1000x1000
EF-2
ISOLATION
PAD
T
400x300
500x400
500 x 400
400x300
1000 x 1000
EF-1
UH-2
A

FLOOR PLAN

SCALE = 1:100


12MM φ STEEL HANGER ROD
AUTOMATIC
AIR VENT
RETURN
UNION (TYP)
SUPPLY
ADJUSTABLE DIFFUSER
UNIT HEATER

## EQUIPMENT SCHEDULE

### UH-1 & UH-2

ENGINEERED AIR MODEL H-10
OUTPUT 45 KW BASED ON 90°C EN
GLYCOL 79°C LEAVING GLYCOL.
ELECTRIC 1/2 H.P. MOTOR 120V, 1
NOTE MOTOR TO BE EXPLOSION P
C/W EXPLOSION PROOF LINE VOL
THERMOSTAT.

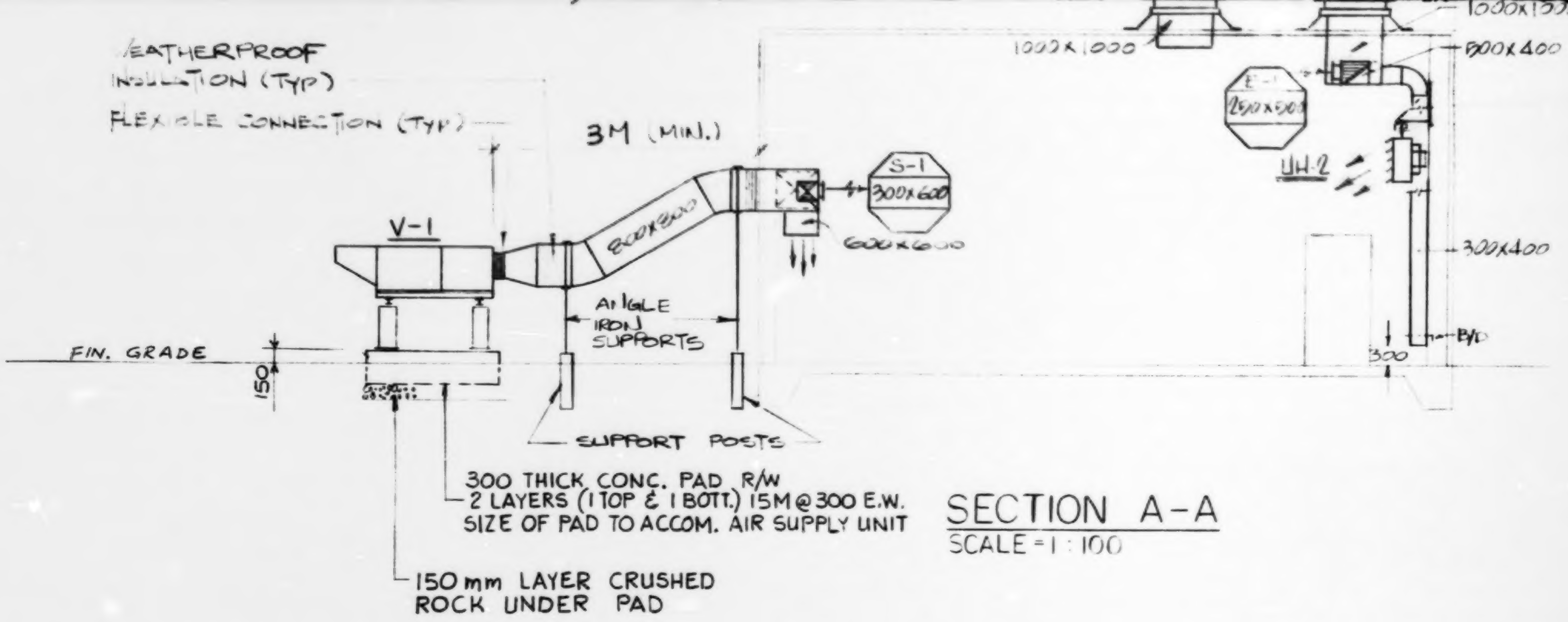
### EF-1 & EF-2

ACME CENTRIMASTER CENTRIFU
UPBLAST BELT DRIVEN EXHAUST F
MODEL PU 300H · 2340 L/S @
C/W PREFABRICATED ROOF CURB
RF AND BACKDRAFT DAMPER.
3/4 H.P. EXPLOSION PROOF MOTOR
3 PHASE UNIT TO BE SUPPLIED W
DISCONNECT SWITCH (UNWIRED).

### V-1

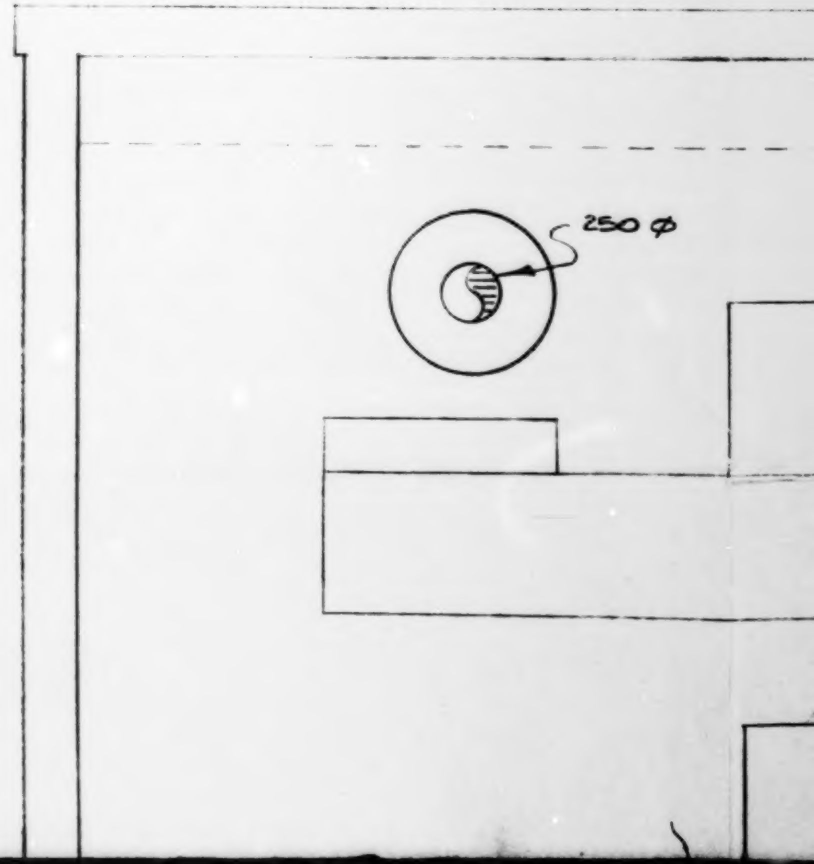
ENGINEERED AIR DIRECT FIRED OUT
MAKE-UP AIR UNIT MODEL HE 1
SUPPLY FAN : 2360 L/S @ 125 Pa E
(DAMPER POSITION 1)
4720 L/S @ 125 Pa E.S.P.
(DAMPER POSITION 2)
MOTOR: 7.5 H.P. 575V 3PHASE
INPUT: 295 KW (N.G.)

90° ELBOW C/W TURNING VANES
PIPING RACK
ISOLATION PAD


WEATHERPROOF INSULATION (TYP)
FLEXIBLE CONNECTION (TYP)
3M (MIN.)
V-1
800x800
S-1
300x600
600x600
ANGLE IRON SUPPORTS
FIN. GRADE
150
SUPPORT POSTS
300 THICK CONC. PAD R/W 2 LAYERS (1 TOP & 1 BOTT.) 15M @ 300 E.W. SIZE OF PAD TO ACCOM. AIR SUPPLY UNIT
150 mm LAYER CRUSHED ROCK UNDER PAD
1000x1000
800x400
EF-1
250x500
UH-2
300x400
B/D
300

SECTION A-A

SCALE = 1 : 100



## EQUIPMENT SCHEDULE

### UH-1 & UH-2

ENGINEERED AIR MODEL H-10
OUTPUT 45 KW BASED ON 90°C ENTERING
GLYCOL 79°C LEAVING GLYCOL.
ELECTRIC 1/2 H.P. MOTOR 120V, 1 PHASE
NOTE MOTOR TO BE EXPLOSION PROOF
C/W EXPLOSION PROOF LINE VOLTAGE
THERMOSTAT.

### EF-1 & EF-2

ACME CENTRIMASTER CENTRIFUGAL
UPBLAST BELT DRIVEN EXHAUST FAN.
MODEL PU 300H · 2340 L/S @ 25 Pa. S.P.
C/W PREFABRICATED ROOF CURB MODEL
RF AND BACKDRAFT DAMPER.
3/4 H.P. EXPLOSION PROOF MOTOR, 575V
3 PHASE UNIT TO BE SUPPLIED WITH
DISCONNECT SWITCH (UNWIRED).

### V-1

ENGINEERED AIR DIRECT FIRED OUTDOOR
MAKE-UP AIR UNIT MODEL HE 100.
SUPPLY FAN : 2360 L/S @ 125 Pa E.S.P.
(DAMPER POSITION 1)
4720 L/S @ 125 Pa E.S.P.
(DAMPER POSITION 2)
MOTOR: 7.5 H.P. 575V 3PHASE
INPUT: 295 KW (N.G.)

## GENERAL NOTES

1. CONTRACTOR TO VERIFY THE LOCATION AND SIZE OF EXISTING NATURAL GAS SERVICE. MAKE CONNECTION TO EXISTING PIPING AND PROVIDE SERVICE TO NEW UNIT V-1 C/W GAS PRESSURE REG. STATION & ISOLATION VALVE. VERIFY SIZE OF LINE AND GAS PRESSURE PRIOR TO ORDERING EQUIPMENT. REMOVE EXISTING GAS PIPING INSIDE BUILDING AND REMOVE 2 EXISTING NATURAL GAS FIRED UNIT HEATERS & CHIMNEYS. CAP AND MAKE SAFE GAS SERVICE OUTSIDE OF BUILDING.

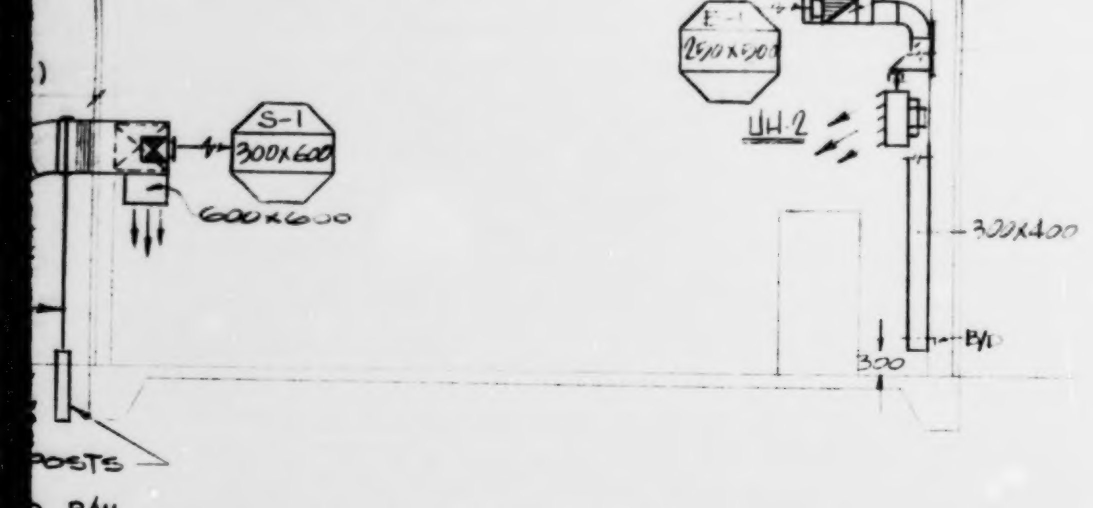
2. GLYCOL PIPING AND SHUT OFF VALVES 2.5M INSIDE BUILDING WILL BE INSTALLED BY A.P.W SUBCONTRACTOR TO CONNECT TO PIPING AND INCLUDE FILL/DRAIN VALVES.

3. SUPPLY GLYCOL SOLUTION COMPATIBLE WITH EXISTING GLYCOL.

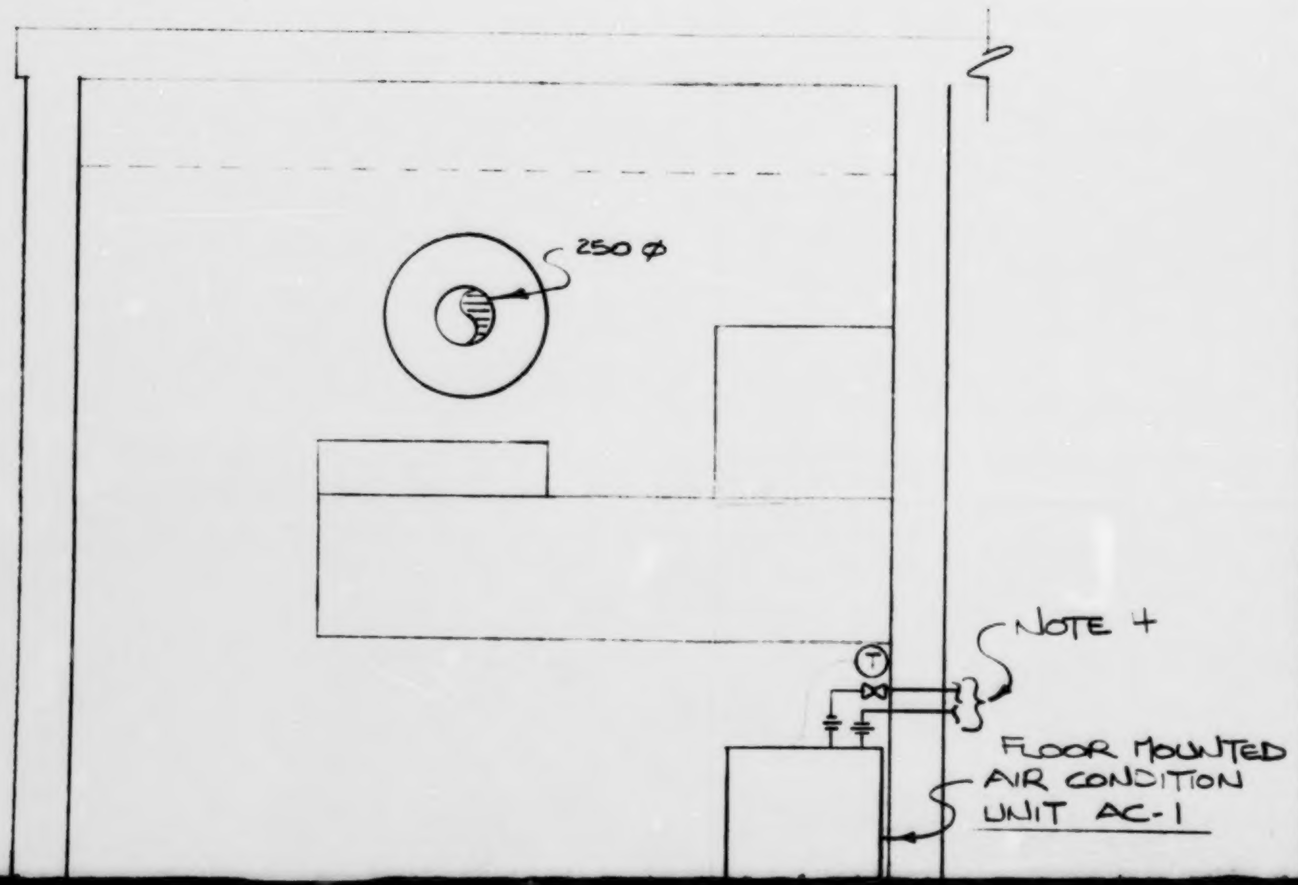
4. FIELD RUN 20MM ⌀ DOMESTIC COLD WATER TO AC-1 AND 20MM ⌀ DRAIN FROM AC-1 TO EXISTING BUILDING SERVICES.

5. PATCH AND MAKE GOOD ALL OPENINGS CAUSED BY REMOVAL OF EXISTING PIPING, EQUIPMENT, CHIMNEYS ETC.

1. CONTRACTOR TO VERIFY THE LOCATION


E-1
2510X510
S-1
300X600
600X600
UH-2
300X400
B/D
300
POSTS
R/W
(T.) 15M @ 300 E.W.
. AIR SUPPLY UNIT

SECTION A-A
SCALE = 1 : 100


250 ⌀
NOTE 4
T
FLOOR MOUNTED
AIR CONDITION
UNIT AC-1

Albertell
871019

PERMIT TO PRACTICE
[illegible]
Signature [illegible]
Date Oct 23, 1987
PERMIT NUMBER: P 4336
The Association of Professional Engineers,
Geologists and Geophysicists of Alberta

**NOTES:** DO NOT SCALE FROM DRAWINGS. REFER TO CEILING AND WINDOW MULLIONS IN RELATION TO PARTITIONS.

CONTRACTOR MUST VERIFY ALL DIMENSIONS; IN CASE OF ERRORS OR DISCREPANCIES ALBERTA PUBLIC WORKS, SUPPLY AND SERVICES MUST BE NOTIFIED.

| | | DATE: |
|---|---|---|
| DESIGNER | | |
| DRAWN BY | V. LAMB | OCT 87 |
| DESIGN SUPERVISOR | T. DORAN | OCT 87 |
| PROJECT MANAGER | J.E. Hurst | 871023 |

**REVISIONS**

| NO. | DRAWN | APPROVE | | DATE: |
|---|---|---|---|---|
| 0 | VL | JEH | ISSUE FOR CONSTRUCTION | 871023. |

Alberta

NORTH

SITE NORTH
N

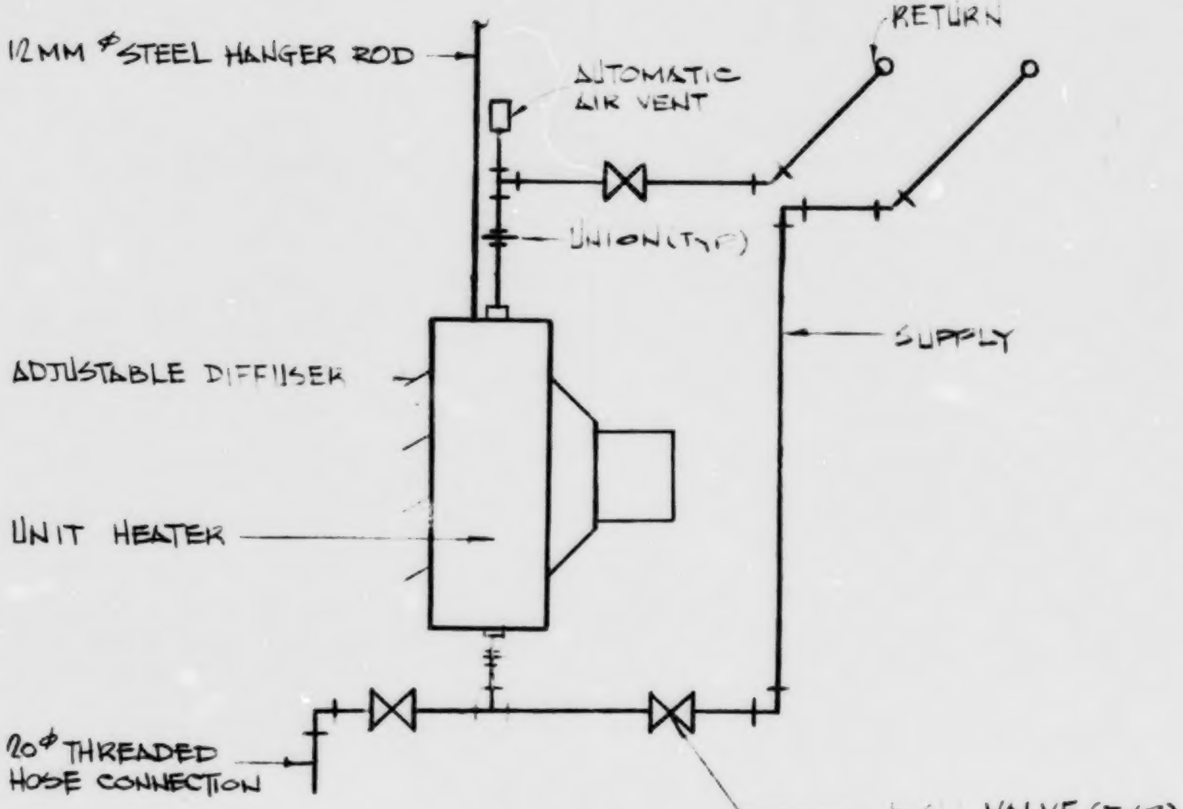
DEVON COAL RESEARCH CENTER

FIELD RESEARCH
MAINTENANCE BUILDING

0 VL JEH ISSUE FOR CONSTRUCTION 871023.

## FLOOR PLAN

SCALE = 1:100



RETURN
12 MM ɸ STEEL HANGER ROD
AUTOMATIC AIR VENT
UNION (TYP.)
SUPPLY
ADJUSTABLE DIFFUSER
UNIT HEATER
20ɸ THREADED HOSE CONNECTION
BALL VALVE (TYP.)

## TYPICAL UNIT HEATER HOOK UP DETAIL

N.T.S.

[illegible]

ENGINEERED AIR MODEL H-10
OUTPUT 45 KW BASED ON 90°C ENT
GLYCOL 79°C LEAVING GLYCOL.
ELECTRIC 1/2 H.P. MOTOR 120V, 1 P
NOTE MOTOR TO BE EXPLOSION PRO
C/W EXPLOSION PROOF LINE VOLTA
THERMOSTAT.

### EF-1 & EF-2

ACME CENTRIMASTER CENTRIFUGA
UPBLAST BELT DRIVEN EXHAUST FA
MODEL PU 300H. 2340 L/S @ 35
C/W PREFABRICATED ROOF CURB MO
RF AND BACKDRAFT DAMPER.
3/4 H.P. EXPLOSION PROOF MOTOR,
3 PHASE UNIT TO BE SUPPLIED WIT
DISCONNECT SWITCH (UNWIRED).

### V-1

ENGINEERED AIR DIRECT FIRED OUTD
MAKE-UP AIR UNIT MODEL HE 100
SUPPLY FAN : 2360 L/S @ 125 Pa E.S
(DAMPER POSITION 1)
4720 L/S @ 125 Pa E.S.P.
(DAMPER POSITION 2)
MOTOR: 7.5 H.P. 575V 3PHASE
INPUT: 295 KW (N.G.)

### AIR OUTLETS

S-1 E.H. PRICE DUCT MOUNTED S
GRILLE MODEL ED 12L C/W O.B.D
B15 FINISH

S-2 & S-3 E.H. PRICE ROUND DIFFUS
MODEL RCDA C/W O.B.D. AND B15
FINISH DUCT MOUNTED

E-1 E.H. PRICE DUCT MOUNTED EXH
GRILLE MODEL ED 80 C/W O.B
AND B15 FINISH.

### AC-1

BUFFALO PACKAGE EQUIPMENT
COOLED AIR CONDITIONING UNIT M
QT310, COMPRESSOR MOTOR: 1.
230V, 60 CYC, 1PH. EVAPORATOR
249 W, 230V 60 CYC, 1PH. UNIT
COMPLETE WITH 24V REMOTE COO
THERMOSTAT AND SUBBASE.

ENGINEERED AIR MODEL H-10
OUTPUT 45 KW BASED ON 90°C ENTERING GLYCOL 79°C LEAVING GLYCOL.
ELECTRIC 1/2 H.P. MOTOR 120V, 1 PHASE
**NOTE** MOTOR TO BE EXPLOSION PROOF C/W EXPLOSION PROOF LINE VOLTAGE THERMOSTAT.

### EF-1 & EF-2

ACME CENTRIMASTER CENTRIFUGAL UPBLAST BELT DRIVEN EXHAUST FAN.
MODEL PU 300H. 2340 L/S @ 25 Pa S.P. C/W PREFABRICATED ROOF CURB MODEL RF AND BACKDRAFT DAMPER.
3/4 H.P. EXPLOSION PROOF MOTOR 575V 3 PHASE UNIT TO BE SUPPLIED WITH DISCONNECT SWITCH (UNWIRED).

### V-1

ENGINEERED AIR DIRECT FIRED OUTDOOR MAKE-UP AIR UNIT MODEL HE 100.
SUPPLY FAN : 2360 L/S @ 125 Pa E.S.P.
(DAMPER POSITION 1)
4720 L/S @ 125 Pa E.S.P.
(DAMPER POSITION 2)
MOTOR : 7.5 H.P. 575V 3PHASE
INPUT : 295 KW (N.G.)

### AIR OUTLETS

S-1 E.H. PRICE DUCT MOUNTED SUPPLY GRILLE MODEL ED 12L C/W O.B.D AND B15 FINISH

S-2 & S-3 E.H. PRICE ROUND DIFFUSER MODEL RCDA C/W O.B.D. AND B15 FINISH DUCT MOUNTED

E-1 E.H. PRICE DUCT MOUNTED EXHAUST GRILLE MODEL ED 80 C/W O.B.D. AND B15 FINISH.

### AC-1

BUFFALO PACKAGE EQUIPMENT WATER COOLED AIR CONDITIONING UNIT MODEL QT310, COMPRESSOR MOTOR: 1.9 KW, 230V, 60 CYC, 1PH. EVAPORATOR MOTOR: 249 W, 230V 60 CYC, 1PH. UNIT TO BE COMPLETE WITH 24V REMOTE COOLING THERMOSTAT AND SUBBASE.

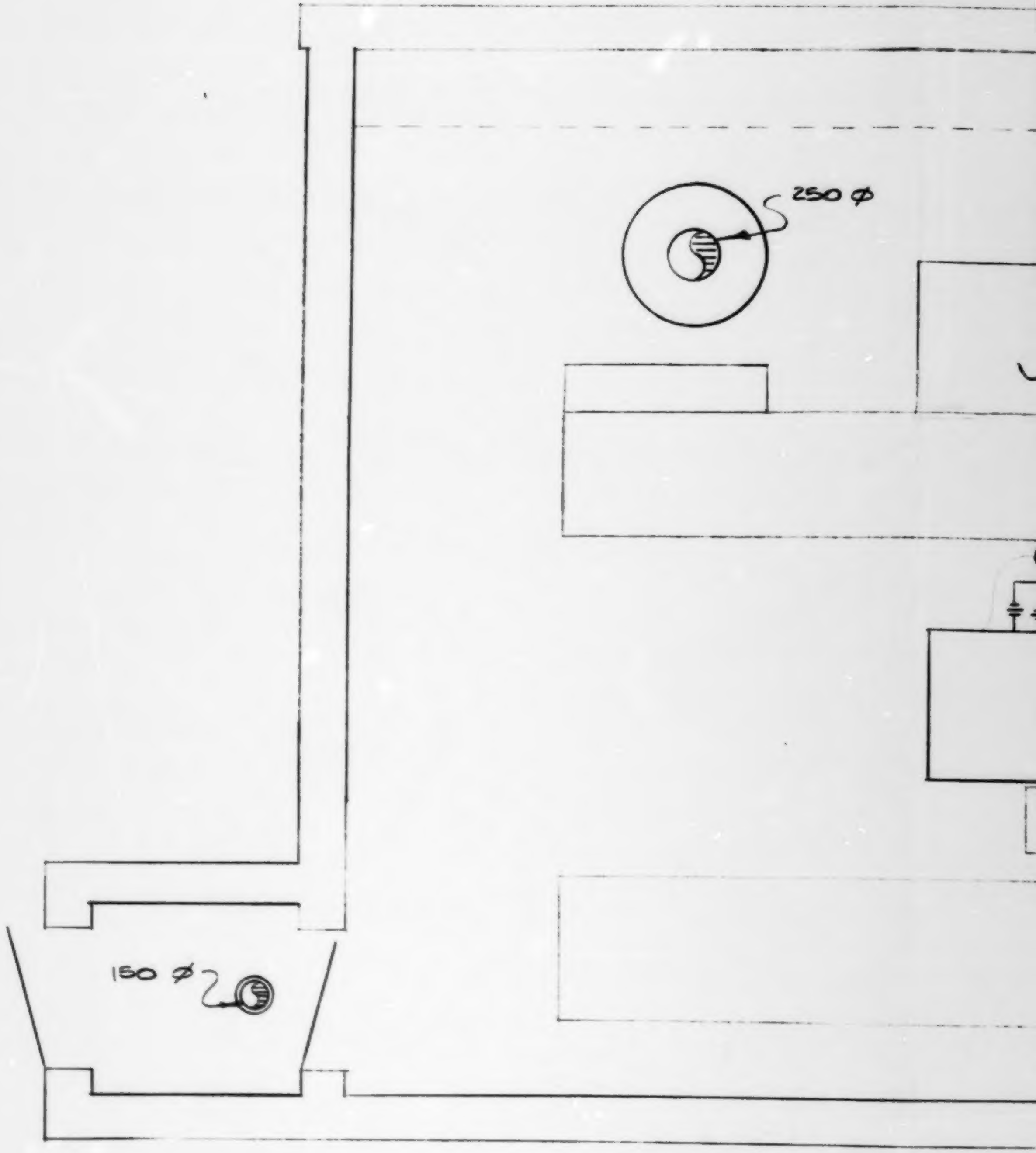
1. CONTRACTOR TO VERIFY THE LOCATION AND SIZE OF EXISTING NATURAL GAS SERVICE. MAKE CONNECTION TO EXISTING PIPING AND PROVIDE SERVICE TO NEW UNIT V-1 C/W GAS PRESSURE REG. STATION & ISOLATION VALVE.
VERIFY SIZE OF LINE AND GAS PRESSURE PRIOR TO ORDERING EQUIPMENT.
REMOVE EXISTING GAS PIPING INSIDE BUILDING AND REMOVE 2 EXISTING NATURAL GAS FIRED UNIT HEATERS & CHIMNEYS.
CAP AND MAKE SAFE GAS SERVICE OUTSIDE OF BUILDING.

2. GLYCOL PIPING AND SHUT OFF VALVES 2.5M INSIDE BUILDING WILL BE INSTALLED BY A.P.W SUBCONTRACTOR TO CONNECT TO PIPING AND INCLUDE FILL/DRAIN VALVES.

3. SUPPLY GLYCOL SOLUTION COMPATIBLE WITH EXISTING GLYCOL.

4. FIELD RUN 20MM Ø DOMESTIC COLD WATER TO AC-1 AND 20MM Ø DRAIN FROM AC-1 TO EXISTING BUILDING SERVICES.

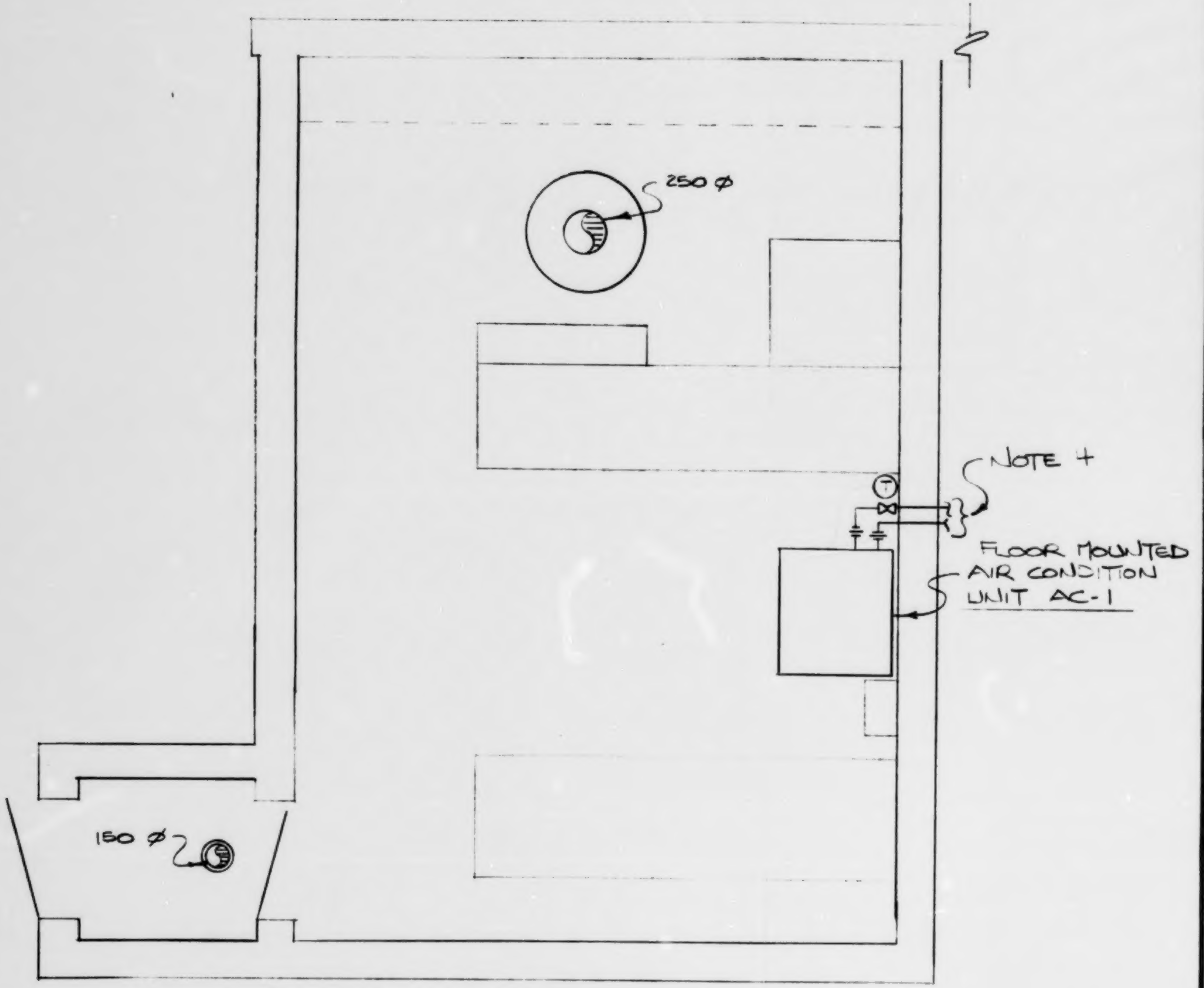
5. PATCH AND MAKE GOOD ALL OPENINGS CAUSED BY REMOVAL OF EXISTING PIPING, EQUIPMENT, CHIMNEYS ETC.
PATCH AND MAKE GOOD ALL OPENINGS PROVIDED FOR NEW INSTALLATION.
PROVIDE FLASHING AS REQ'D.



### FLOOR PLAN - CONTROL ROOM

SCALE: 1:25

ISSUE FOR CONSTRUCTION


250 ø
NOTE 4
FLOOR MOUNTED AIR CONDITION UNIT AC-1
150 ø

FLOOR PLAN - CONTROL ROOM
SCALE: 1:25

Alberta

**NORTH**

SITE NORTH
N

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FIELD RESEARCH
MAINTENANCE BUILDING

**INDEX**

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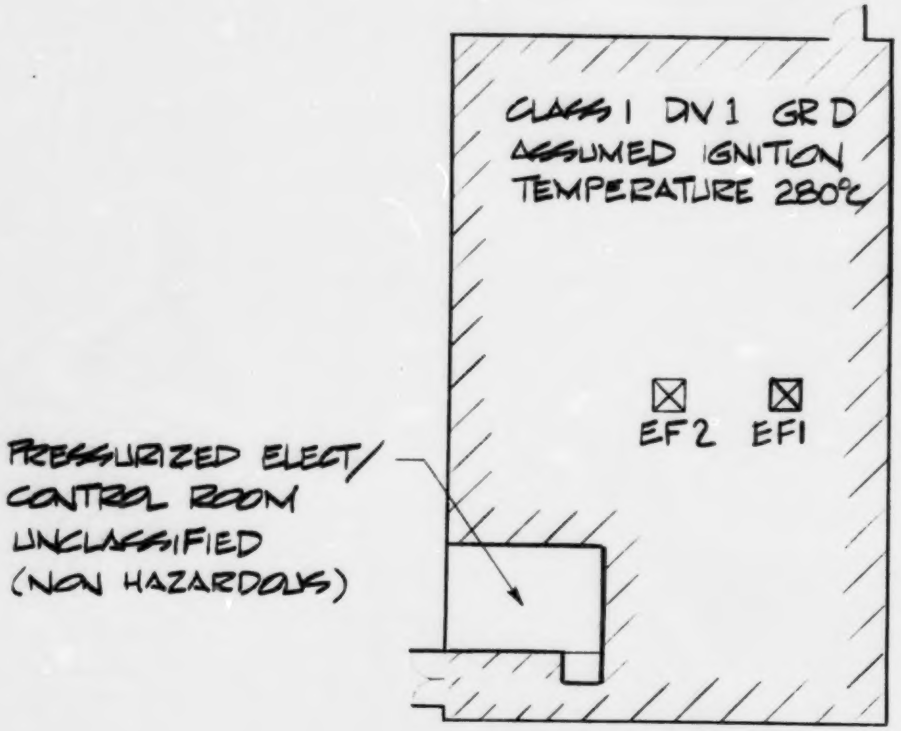
SIGNAGE PLAN
SPECIAL REQUIREMENTS PLAN
DETAILS
FINISH PLAN
ELECTRICAL CONSULTANTS PLAN
MECHANICAL CONSULTANTS PLAN

**FLOOR**

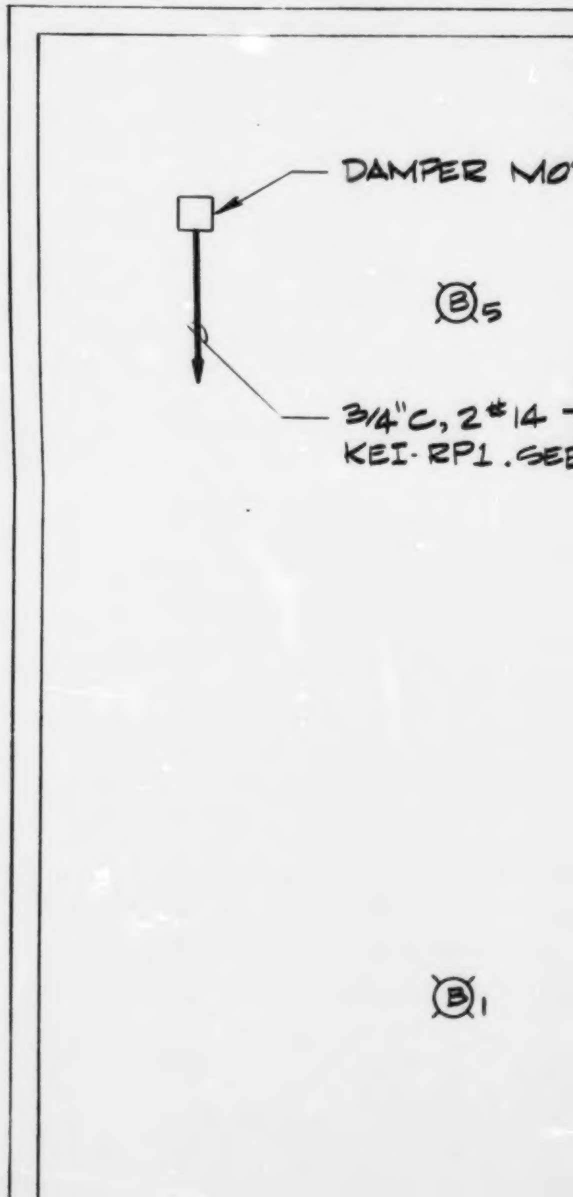
**DRAWING DESCRIPTION**
H.V.A.C. LAYOUT

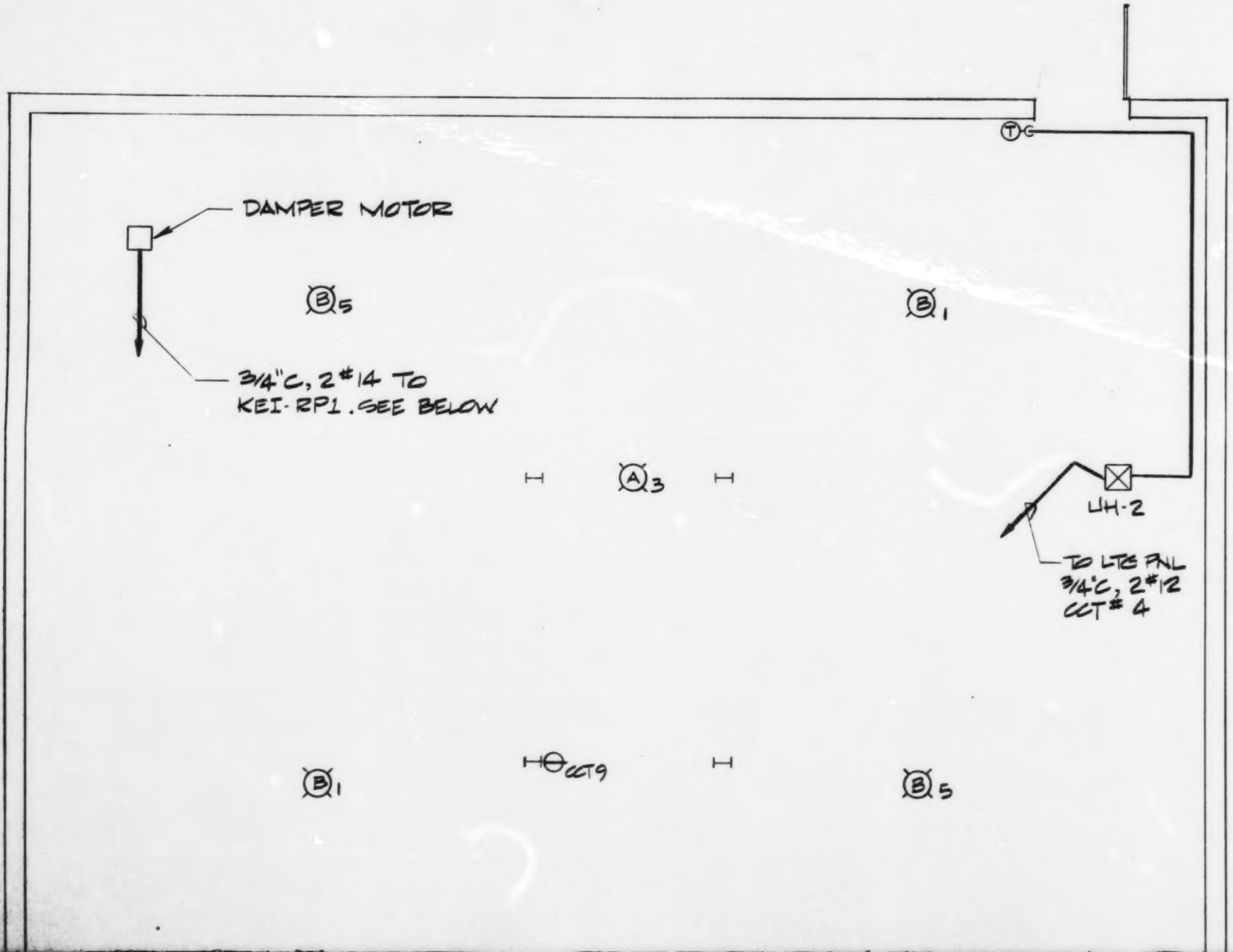
**SCALE (METRIC)** AS SHOWN
**PROJECT NUMBER**
**SHEET** 1 **OF** 1
**BUILDING NUMBER**
**DRAWING NUMBER** 301


CLASS I DIV 1 GR D
ASSUMED IGNITION
TEMPERATURE 280°C
EF2
EF1
PRESSURIZED ELECT/
CONTROL ROOM
UNCLASSIFIED
(NON HAZARDOUS)

AREA CLASSIFICATION

NTS


DAMPER MO
Ⓑ5
3/4"C, 2#14 –
KEI-RP1. SE
Ⓑ1


DAMPER MOTOR
B5
B1
3/4"C, 2#14 TO KEI-RP1. SEE BELOW
A3
CCT9
B1
B5
UH-2
TO LTG PNL 3/4"C, 2#12 CCT# 4
T

NOTES

1. PLANT AREA IS C
CLASS I. GROUP
INSTALLATION AN
CONFORM TO THI
CONDUIT AND CA
BE PROVIDED A
ELECTRICAL COD
1986 EDITION.

2. SUPPORT CONDUI
ROOM TO AIR M
DUCTWORK POST

3. SUBCONTRACTOR
REQUIRED, COND
MAKEUP UNIT T
ROOM.

NOTES

1. PLANT AREA IS CLASSIFIED AS CLASS I. GROUP D, DIV 1. INSTALLATION AND MATERIALS SHALL CONFORM TO THIS CLASSIFICATION. CONDUIT AND CABLE SEALS MUST BE PROVIDED AS PER CANADIAN ELECTRICAL CODE, PART I, SECTION 18 1986 EDITION.
2. SUPPORT CONDUIT RUN FROM ELECTRICAL ROOM TO AIR MAKEUP UNIT FROM DUCTWORK POSTS.
3. SUBCONTRACTOR TO SUPPORT AS REQUIRED, CONDUITS FROM AIR MAKEUP UNIT TO EXISTING ELECTRICAL ROOM.

**Alberta**
**PUBLIC WORKS,**
**SUPPLY AND SERVICES**
**Property Planning Division**

A.P.W.S.S. USE ONLY

PROFESSIONAL ENGINEER ALBERTA
S. BASAFFA
87/10/21

PERMIT TO PRACTICE
KILBORN ENERGY INC
Signature
Date OCT 21/87
PERMIT NUMBER: P [illegible]

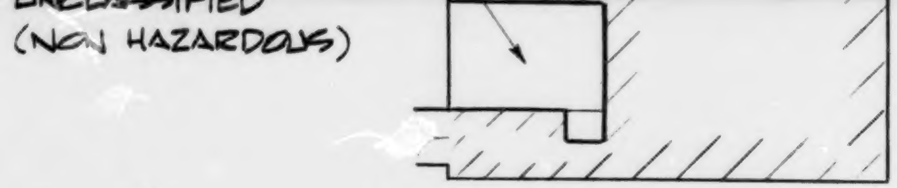
KILBORN

PROJECT NO: A149-15

NOTES: DO NOT SCALE FROM DRAWINGS. REFER TO CEILING AND WINDOW MULLIONS IN RELATION TO PARTITIONS.

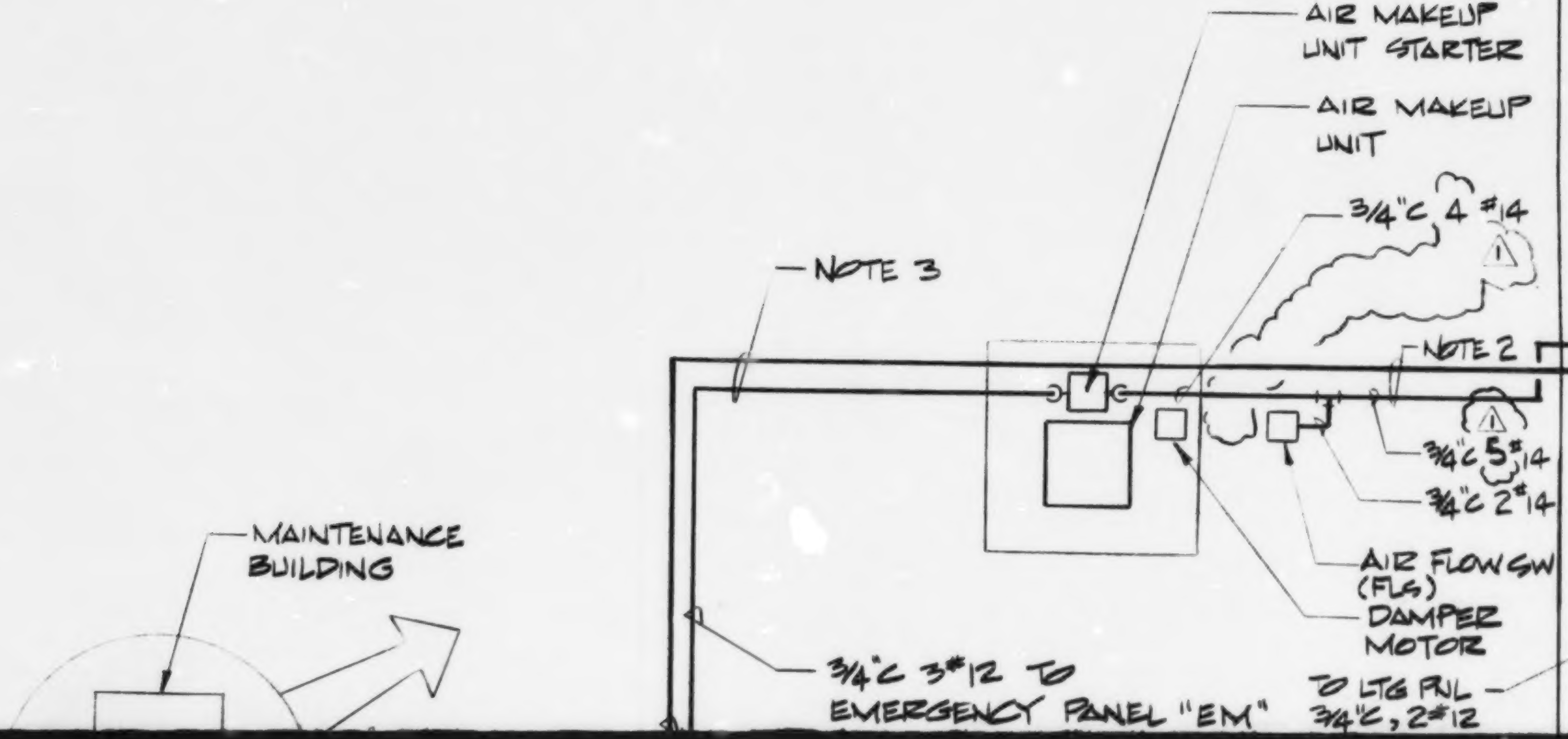
CONTRACTOR MUST VERIFY ALL DIMENSIONS; IN CASE OF ERRORS OR DISCREPANCIES ALBERTA PUBLIC WORKS, SUPPLY AND SERVICES MUST BE NOTIFIED.

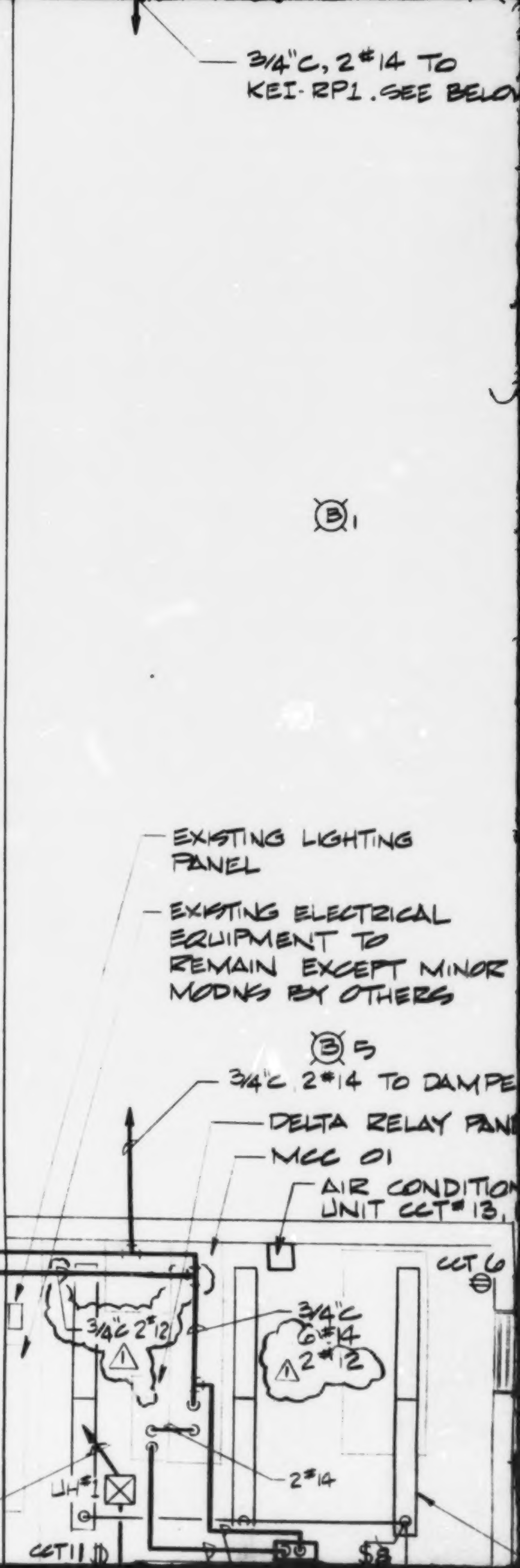
| | | |
|---|---|---|
| DESIGNER | | DATE: |
| DRAWN BY | S.TURK | 21 OCT.87 |

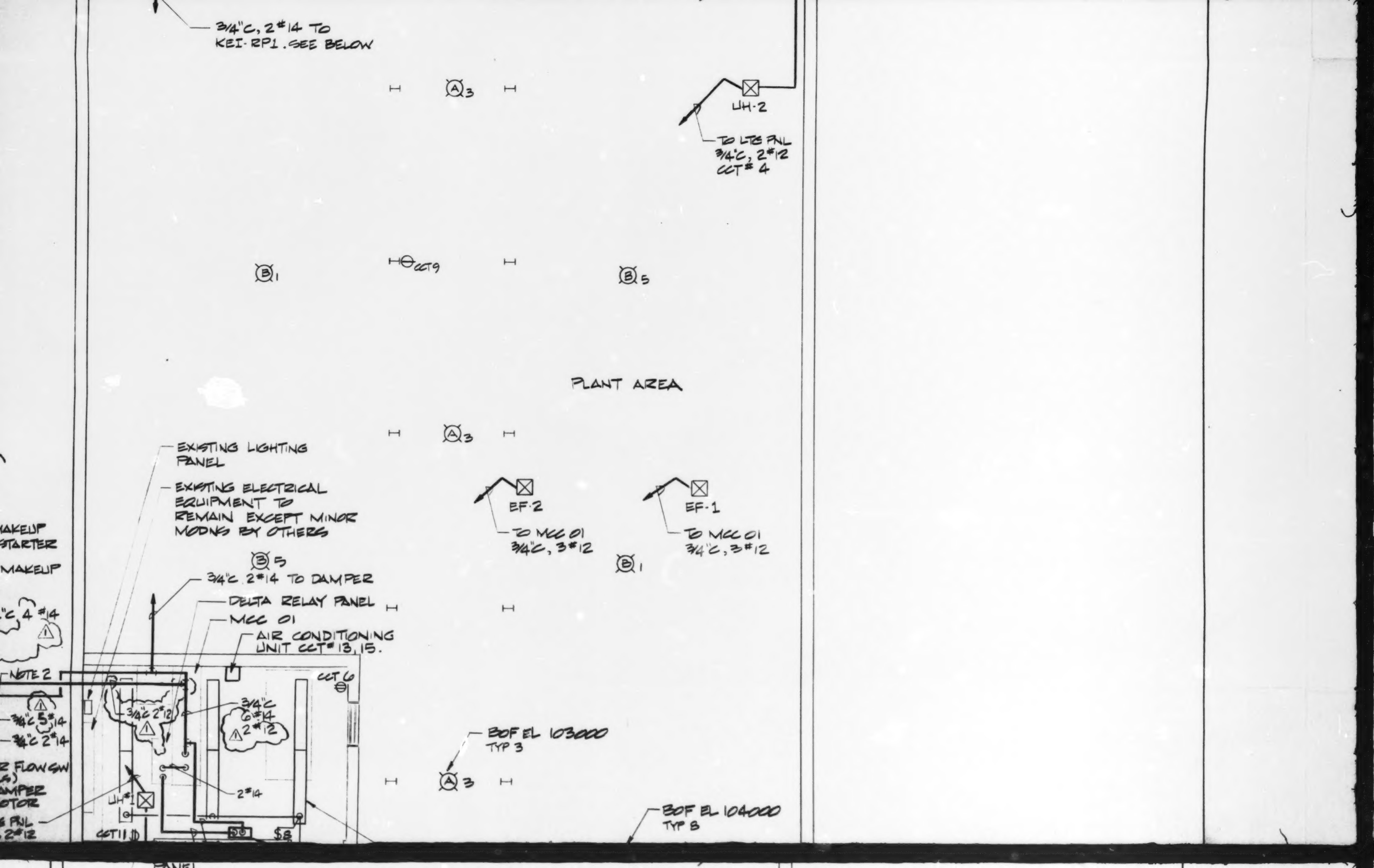

(NON HAZARDOUS)

## AREA CLASSIFICATION

NTS


AIR MAKEUP UNIT STARTER
AIR MAKEUP UNIT
3/4"C 4 #14
NOTE 3
NOTE 2
3/4"C 5#14
3/4"C 2#14
AIR FLOW SW (FLS)
DAMPER MOTOR
MAINTENANCE BUILDING
3/4"C 3#12 TO EMERGENCY PANEL "EM"
TO LTG PNL 3/4"C, 2#12


3/4"C, 2#14 TO KEI-RP1. SEE BELO
③1
EXISTING LIGHTING PANEL
EXISTING ELECTRICAL EQUIPMENT TO REMAIN EXCEPT MINOR MODNS BY OTHERS
③5
3/4"C 2#14 TO DAMPE
DELTA RELAY PAN
MCC 01
AIR CONDITIO UNIT CCT# 13,
CCT 6
3/4"C 2#12
3/4"C 6#14 2#12
2#14
UH#1
CCT 11
$B


3/4"C, 2#14 TO
KEI-RP1. SEE BELOW
A 3
UH-2
TO LTG PNL
3/4"C, 2#12
CCT# 4
B 1
CCT9
B 5
PLANT AREA
A 3
EXISTING LIGHTING
PANEL
EXISTING ELECTRICAL
EQUIPMENT TO
REMAIN EXCEPT MINOR
MODNS BY OTHERS
EF-2
TO MCC 01
3/4"C, 3#12
EF-1
TO MCC 01
3/4"C, 3#12
B 1
MAKEUP
STARTER
MAKEUP
B 5
3/4"C 2#14 TO DAMPER
DELTA RELAY PANEL
MCC 01
AIR CONDITIONING
UNIT CCT# 13, 15.
"C, 4 #14
NOTE 2
CCT 6
3/4"C 5#14
3/4"C 2#14
3/4"C 2#12
3/4"C
6#14
2#12
BOF EL 103000
TYP 3
R FLOW SW
AMPER
OTOR
2#14
UH#1
A 3
PNL
2#12
CCT11
$8
BOF EL 104000
TYP B
PANEL

S. BASAPPA
87/10/21

PERMIT TO PRACTICE
KILBORN ENERGY INC
Signature
Date OCT 21/87
PERMIT NUMBER: P [illegible]

**KILBORN**

PROJECT NO: A149-15

**NOTES:**

DO NOT SCALE FROM DRAWINGS. REFER TO CEILING AND WINDOW MULLIONS IN RELATION TO PARTITIONS.

CONTRACTOR MUST VERIFY ALL DIMENSIONS; IN CASE OF ERRORS OR DISCREPANCIES ALBERTA PUBLIC WORKS, SUPPLY AND SERVICES MUST BE NOTIFIED.

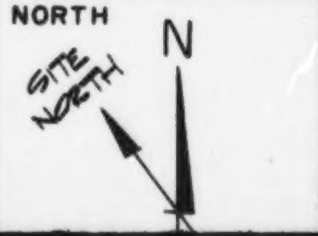
| | | DATE: |
|---|---|---|
| DESIGNER | | |
| DRAWN BY | S. TURK | 21 OCT. 87 |
| DESIGN SUPERVISOR | S Basappa | 21 OCT 87 |
| PROJECT MANAGER | JE H[illegible] | 23 OCT 87 |

**REVISIONS**

| NO. | DRAWN | APPROVE | | DATE: |
|---|---|---|---|---|
| 0 | ST | JEH | ISSUED FOR CONSTRUCTION | 21 OCT. 87 |
| 1 | ST | SB JEH | DELETED WIRING TO AIR M/U UNIT | 6 JAN. 88 |

Alberta

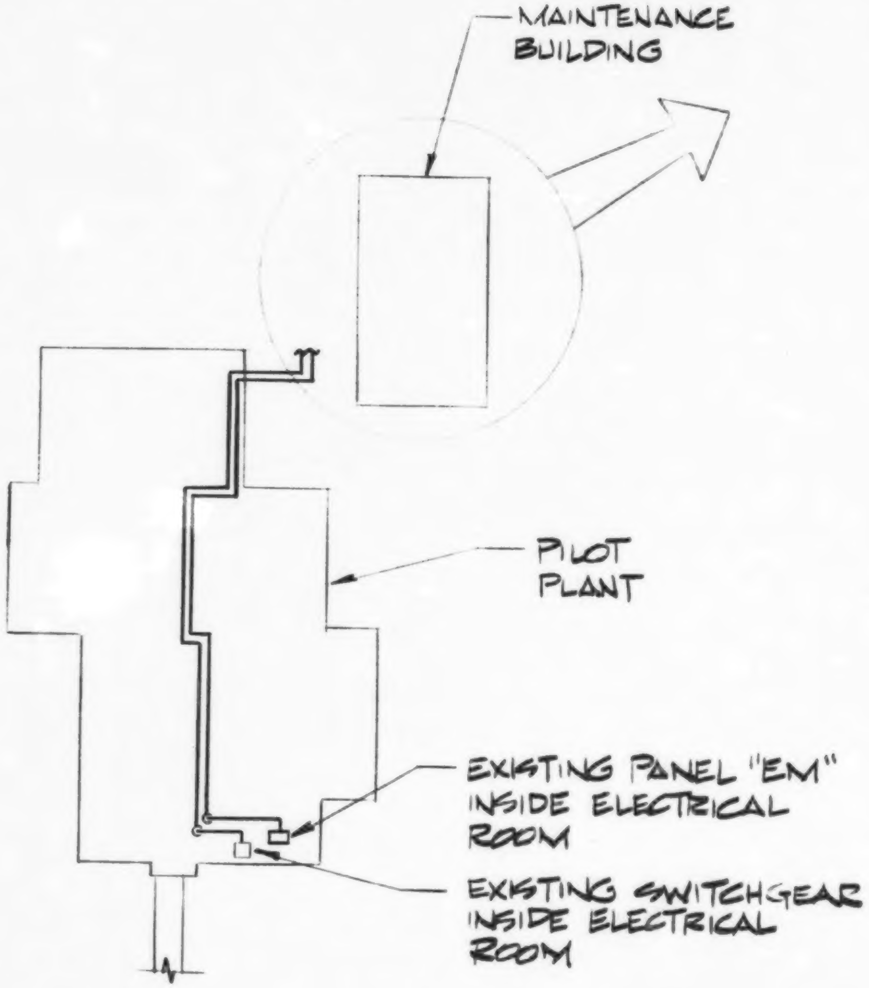
NORTH

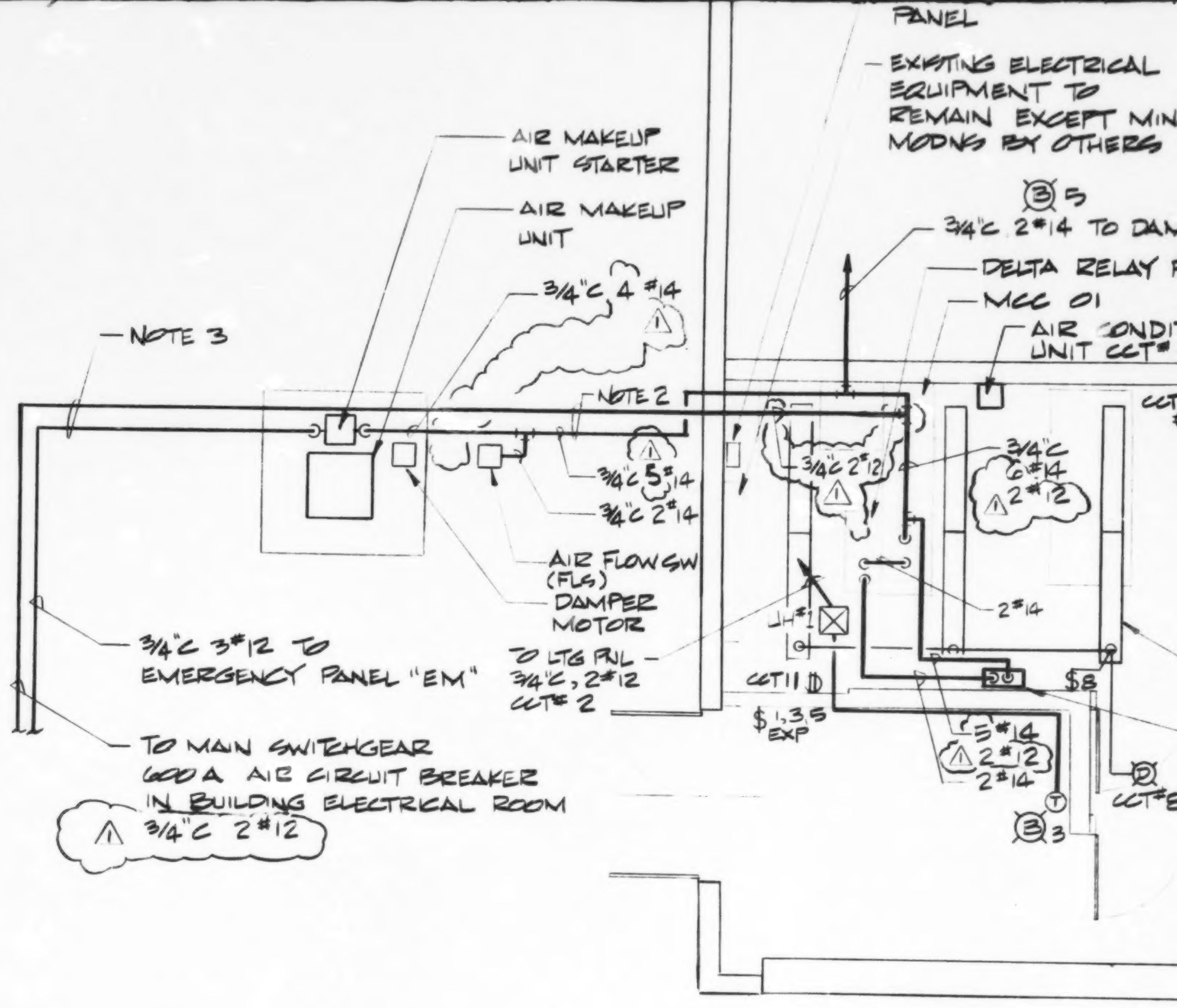


DEVON COAL RESEARCH CENTER

FIELD RESEARCH
MAINTENANCE BUILDING

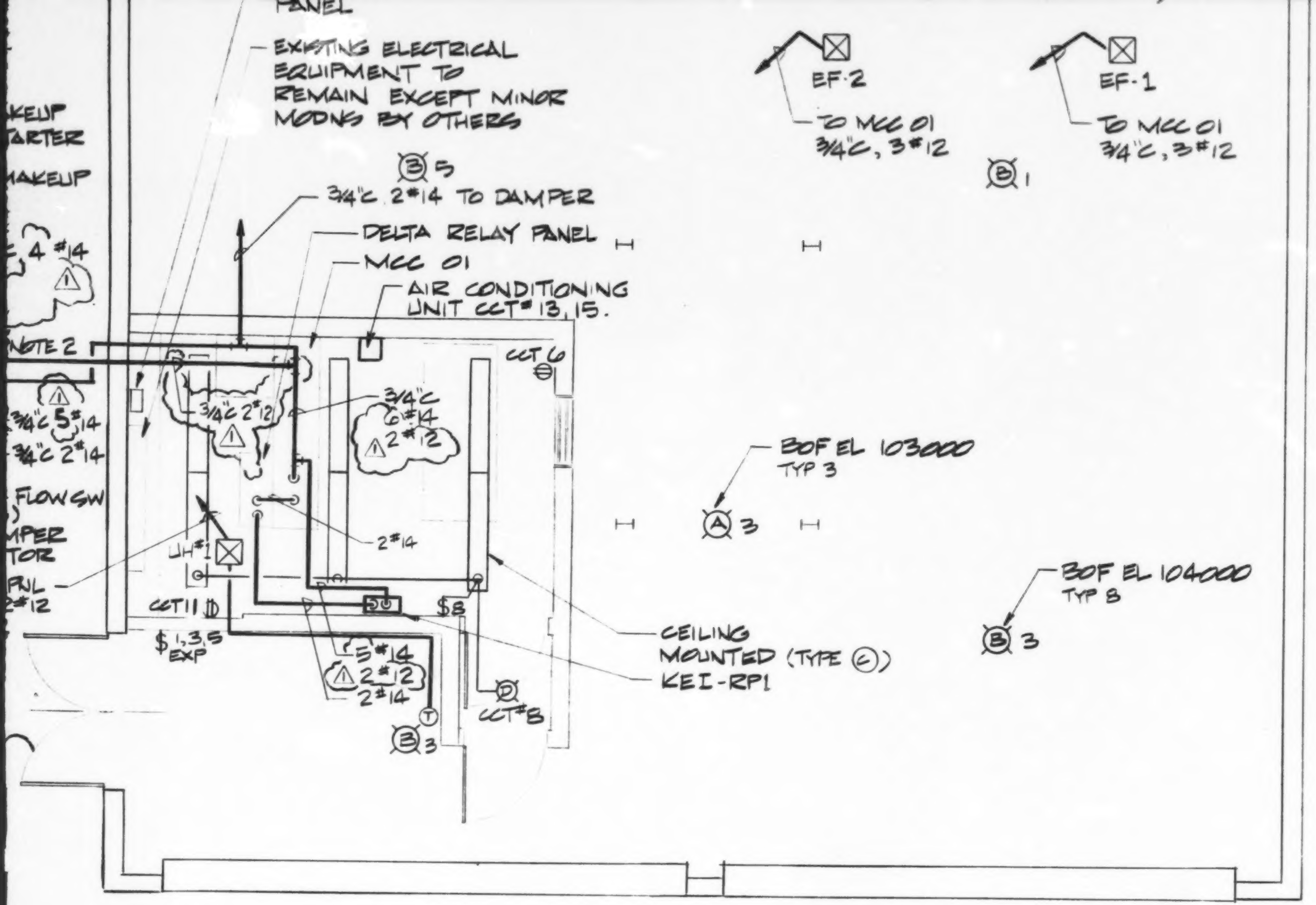
0 ST JEH ISSUED FOR CONSTRUCTION 21 OCT. 87


MAINTENANCE BUILDING
PILOT PLANT
EXISTING PANEL "EM" INSIDE ELECTRICAL ROOM
EXISTING SWITCHGEAR INSIDE ELECTRICAL ROOM


PANEL
EXISTING ELECTRICAL EQUIPMENT TO REMAIN EXCEPT MIN
MODNS BY OTHERS
③ 5
3/4"C 2#14 TO DAM
DELTA RELAY
MCC 01
AIR CONDIT UNIT CCT#
AIR MAKEUP UNIT STARTER
AIR MAKEUP UNIT
3/4"C 4 #14 ⚠
NOTE 3
NOTE 2
⚠ 3/4"C 5#14
3/4"C 2#14
3/4"C 2#12 ⚠
3/4"C 6#14 ⚠ 2#12
AIR FLOW SW (FLS)
DAMPER MOTOR
2#14
UH#1
CCT11
$ 1,3,5 EXP
5#14
⚠ 2#12
2#14
$8
CCT#
③ 3
3/4"C 3#12 TO EMERGENCY PANEL "EM"
TO LTG PNL - 3/4"C, 2#12 CCT# 2
TO MAIN SWITCHGEAR 600A AIR CIRCUIT BREAKER IN BUILDING ELECTRICAL ROOM
⚠ 3/4"C 2#12

LIGHTING AND PO

1:50


PANEL
EXISTING ELECTRICAL EQUIPMENT TO REMAIN EXCEPT MINOR MODNS BY OTHERS
EF-2
EF-1
TO MCC 01 3/4"C, 3#12
TO MCC 01 3/4"C, 3#12
B 5
B 1
3/4"C 2#14 TO DAMPER
DELTA RELAY PANEL
MCC 01
AIR CONDITIONING UNIT CCT# 13, 15.
AKEUP
ARTER
AKEUP
4 #14
NOTE 2
3/4"C 5#14
3/4"C 2#14
FLOW SW
MPER
TOR
PNL
2#12
CCT 6
3/4"C 2#12
3/4"C 6#14 2#12
2#14
UH#1
CCT11
$ 1,3,5 EXP
$8
5#14
2#12
2#14
T
B 3
D
CCT#8
BOF EL 103000 TYP 3
A 3
BOF EL 104000 TYP 8
B 3
CEILING MOUNTED (TYPE C)
KEI-RP1

LIGHTING AND POWER PLAN
1:50

Alberta

NORTH

N
SITE NORTH

DEVON COAL RESEARCH CENTER

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MAINTENANCE BUILDING

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| ☐ | DETAILS |
| ☐ | FINISH PLAN |
| ■ | ELECTRICAL CONSULTANTS PLAN |
| ☐ | MECHANICAL CONSULTANTS PLAN |

FLOOR

DRAWING DESCRIPTION

AREA CLASSIFICATION,
LIGHTING AND POWER
PLAN

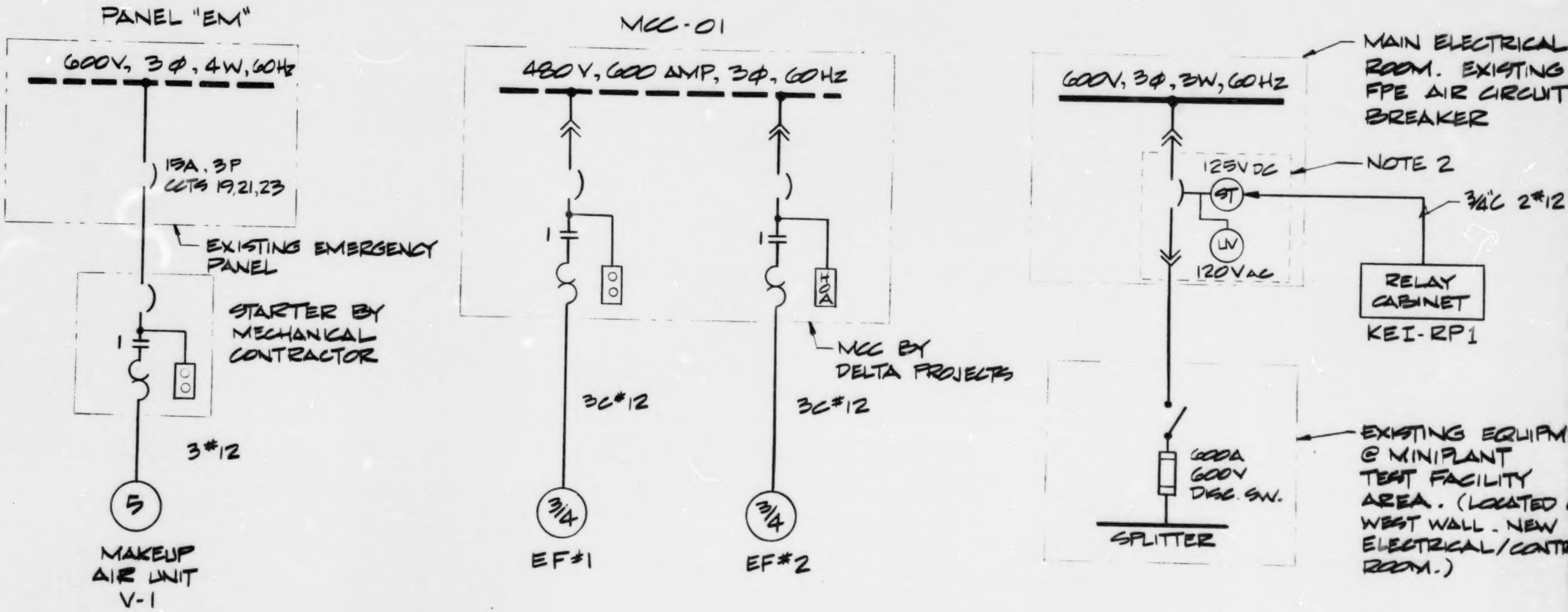
SCALE (METRIC)
AS SHOWN

PROJECT NUMBER

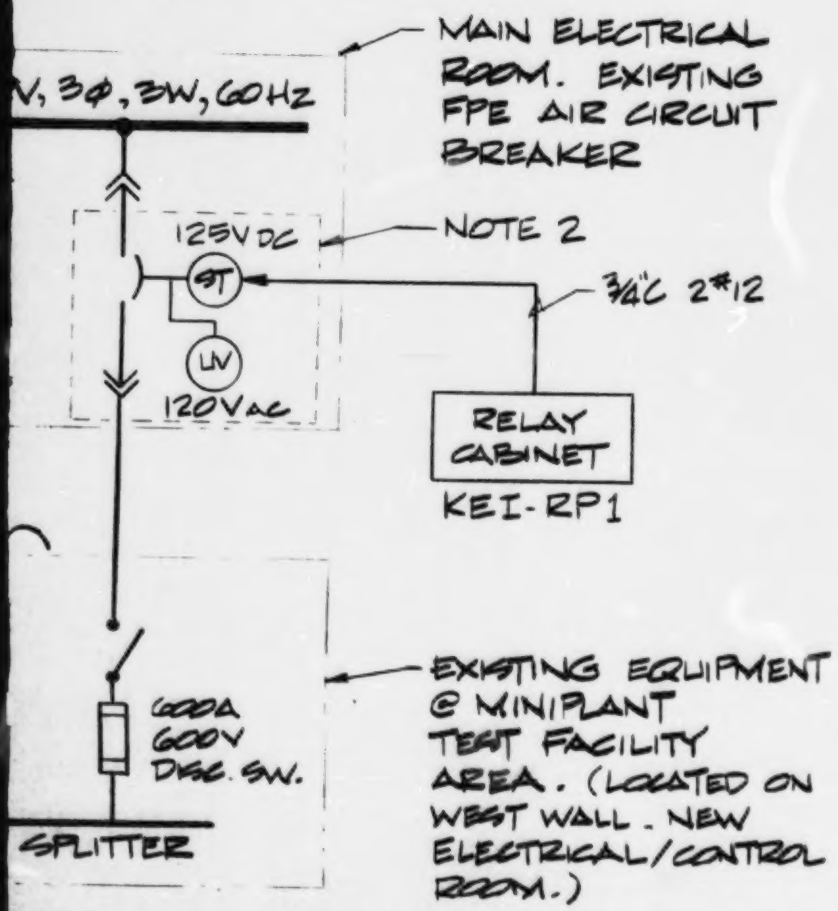
SHEET 1 OF 2

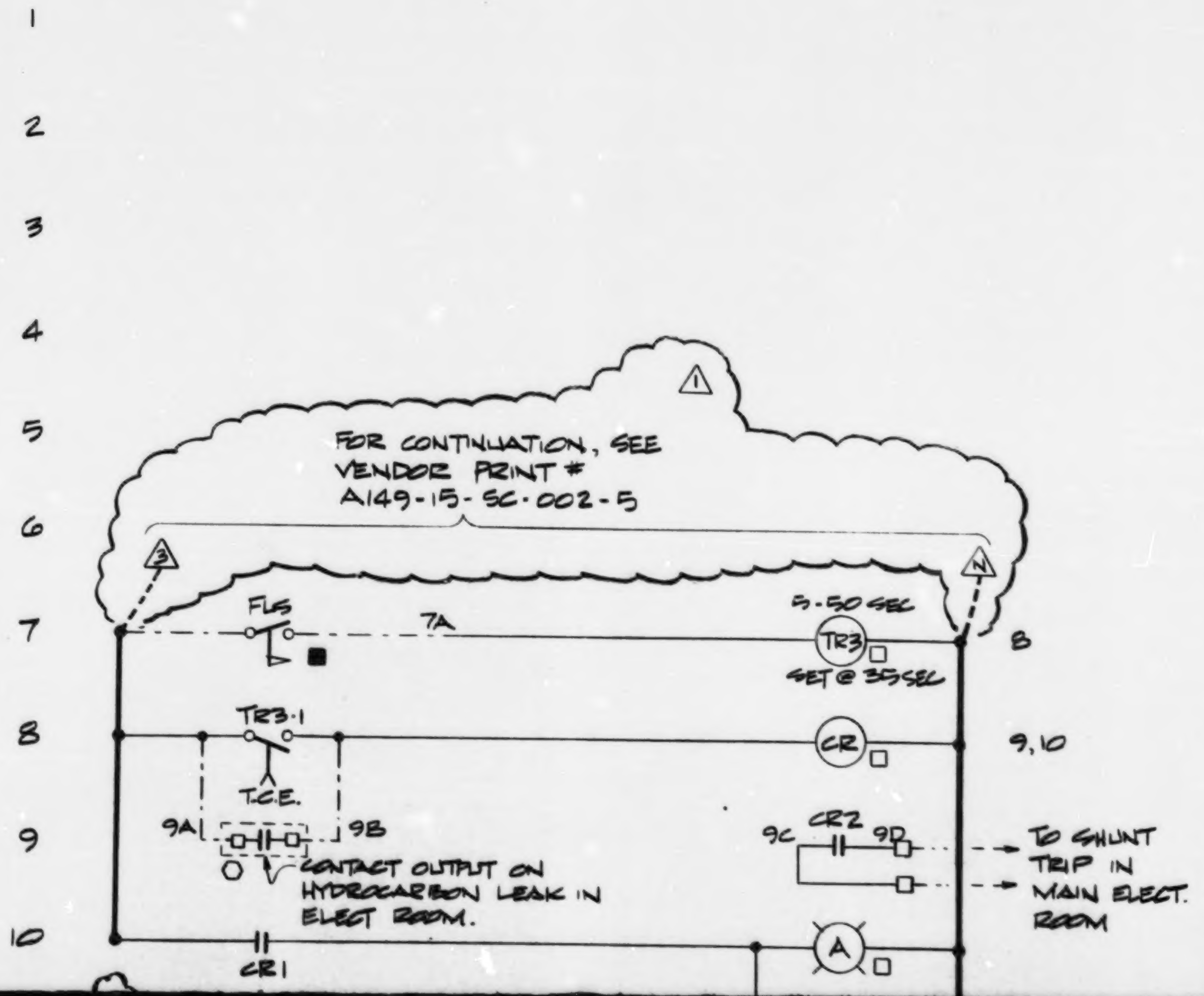
BUILDING NUMBER

DRAWING NUMBER 401


PANEL "EM"
600V, 3φ, 4W, 60Hz
15A, 3P
CCTS 19,21,23
EXISTING EMERGENCY PANEL
1
STARTER BY MECHANICAL CONTRACTOR
3#12
5
MAKEUP AIR UNIT
V-1
MCC-01
480V, 600 AMP, 3φ, 60HZ
1
1
HOA
MCC BY DELTA PROJECTS
3C#12
3C#12
3/4
3/4
EF#1
EF#2
600V, 3φ, 3W, 60Hz
MAIN ELECTRICAL ROOM. EXISTING FPE AIR CIRCUIT BREAKER
125V DC
NOTE 2
ST
UV
120Vac
3/4"C 2#12
RELAY CABINET
KEI-RP1
600A
600V
DISC. SW.
SPLITTER
EXISTING EQUIPM
@ MINIPLANT
TEST FACILITY
AREA. (LOCATED
WEST WALL. NEW
ELECTRICAL/CONT
ROOM.)

SINGLE LINE DIAGRAMS


MAIN ELECTRICAL ROOM. EXISTING FPE AIR CIRCUIT BREAKER
V, 3φ, 3W, 60Hz
125V DC
NOTE 2
ST
UV
120Vac
3/4"C 2#12
RELAY CABINET
KEI-RP1
600A 600V DISC. SW.
SPLITTER
EXISTING EQUIPMENT @ MINIPLANT TEST FACILITY AREA. (LOCATED ON WEST WALL. NEW ELECTRICAL/CONTROL ROOM.)


1
2
3
4
5
6
7
8
9
10
1
FOR CONTINUATION, SEE VENDOR PRINT # A149-15-SC-002-5
3
N
FLS
7A
5-50 SEC
TR3
SET @ 35 SEC
8
TR3-1
CR
9,10
T.C.E.
9A
9B
CONTACT OUTPUT ON HYDROCARBON LEAK IN ELECT ROOM.
9C
CR2
9D
TO SHUNT TRIP IN MAIN ELECT. ROOM
CR1
A

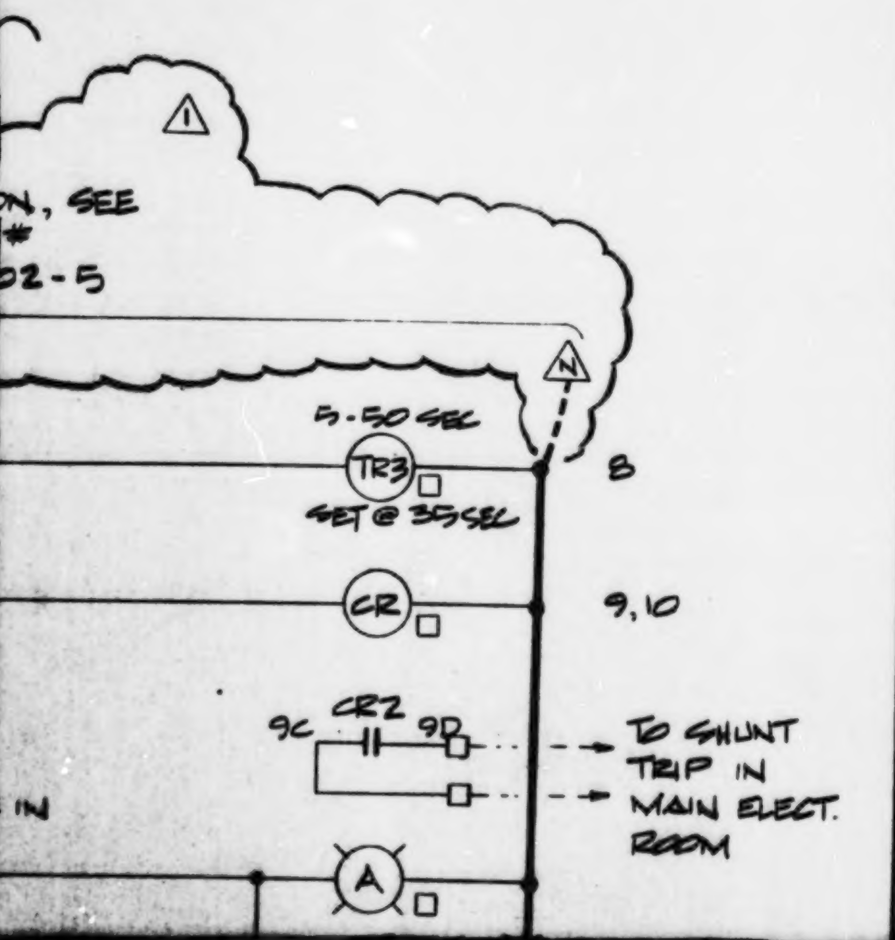
## LEGEND

▲ LOCATED IN STARTER -
△ LOCATED IN STARTER -
☐ LOCATED IN KEI-RP1
■ LOCATED IN FIELD
○ LOCATED IN DELTA RP
-·- FIELD WIRING OR WIR
CABINET TO CABINE
—— INTERNAL WIRING. M
RELAY PANEL.

## NOTES

1. PARTIAL SINGLE LINE
THAT IS RELEVANT T
IS SHOWN ON THIS

2. DUE TO LOSS OF POW
INITIATING SHUNT TRI
BREAKER SUPPLYING
THE MINI PLANT WILL
PRIOR TO CLOSING TH
THE OPERATING / MAIN
PERSONNEL SHALL EN
THE MINI PLANT ELECT
ROOM IS PROPERLY
AND IT IS SAFE TO
POWER ON.



## LEGEND

| | |
|---|---|
| ▲ | LOCATED IN STARTER - MCC 01 |
| △ | LOCATED IN STARTER - FIELD |
| □ | LOCATED IN KEI-RP1 |
| ■ | LOCATED IN FIELD |
| ⬡ | LOCATED IN DELTA RP |
| - · — | FIELD WIRING OR WIRING FROM CABINET TO CABINET. |
| —— | INTERNAL WIRING. MCC, STARTER OR RELAY PANEL. |

## NOTES

1. PARTIAL SINGLE LINE INFORMATION THAT IS RELEVANT TO THE SCOPE IS SHOWN ON THIS DRAWING.
2. DUE TO LOSS OF POWER OR INITIATING SHUNT TRIP, THE MAIN BREAKER SUPPLYING POWER TO THE MINI PLANT WILL BE OPENED. PRIOR TO CLOSING THIS BREAKER, THE OPERATING / MAINTENANCE PERSONNEL SHALL ENSURE THAT THE MINI PLANT ELECTRICAL / CONTROL ROOM IS PROPERLY PRESSURIZED AND IT IS SAFE TO TURN THE POWER ON.

Alberta
PUBLIC WORKS,
SUPPLY AND SERVICES
Property Planning Division

A.P.W.S.S. USE ONLY

PROFESSIONAL ENGINEER
S. BASAPPA
87/10/21
ALBERTA

PERMIT TO PRACTICE
KILBORN ENERGY INC.
Signature
Date OCT 4 87
PERMIT NUMBER: P 4386
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

KILBORN

PROJECT NO: A149-15

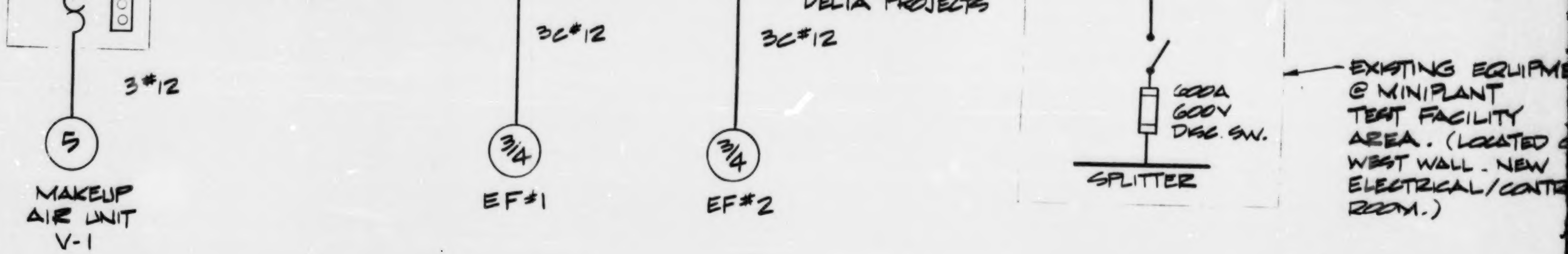
**NOTES:**

DO NOT SCALE FROM DRAWINGS. REFER TO CEILING AND WINDOW MULLIONS IN RELATION TO PARTITIONS.

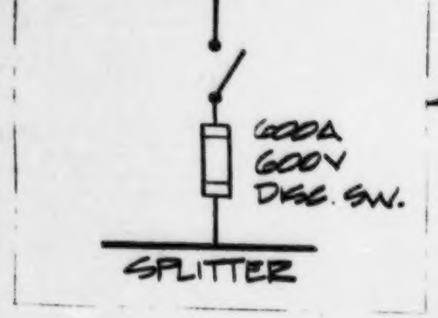
CONTRACTOR MUST VERIFY ALL DIMENSIONS; IN CASE OF ERRORS OR DISCREPANCIES ALBERTA PUBLIC WORKS, SUPPLY AND SERVICES MUST BE NOTIFIED.

DESIGNER

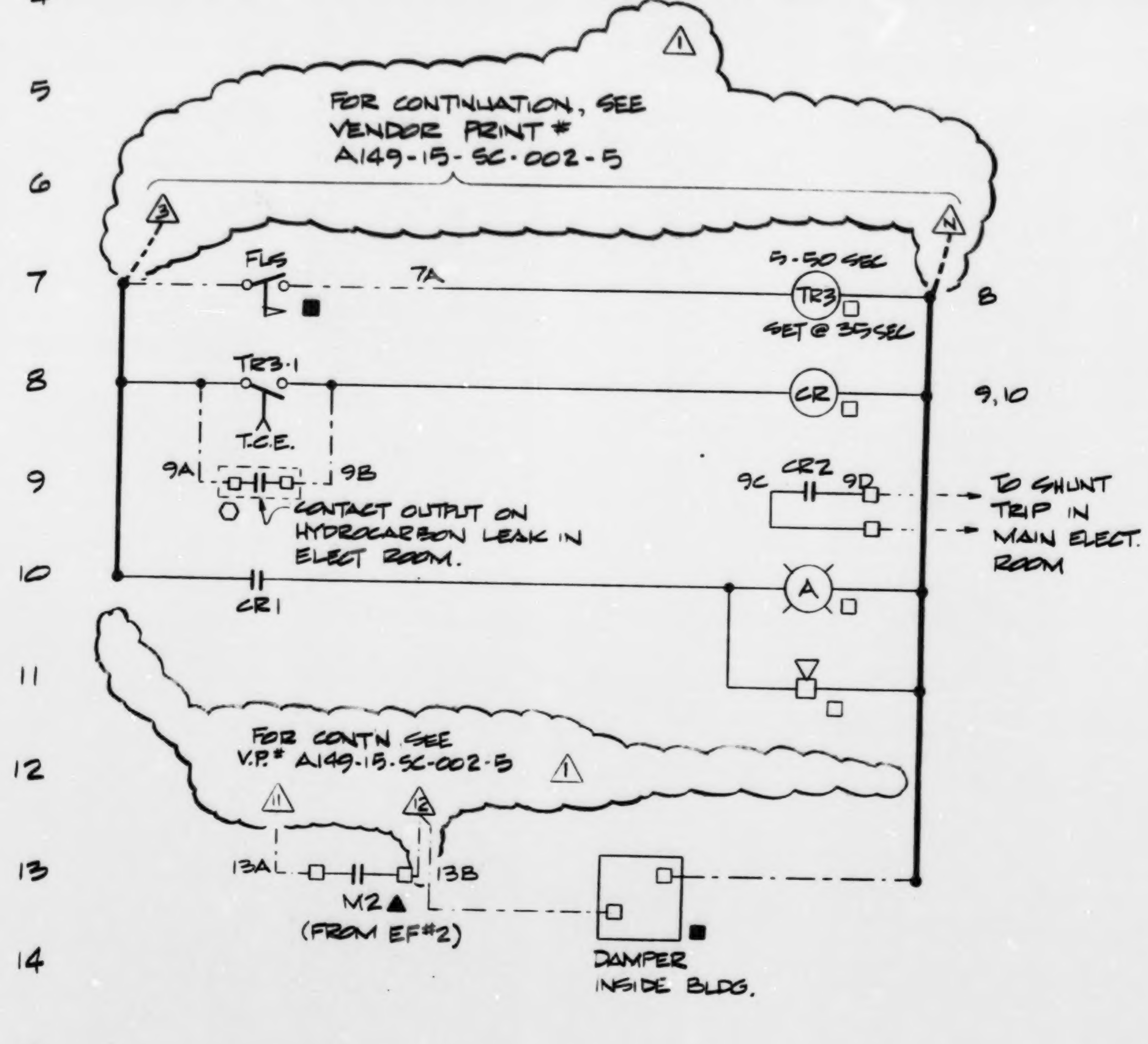
IS SHOWN ON THIS DRAWING.


DELTA PROJECTS
3#12
5
MAKEUP
AIR UNIT
V-1
3c#12
3/4
EF#1
3c#12
3/4
EF#2
600A
600V
DISC. SW.
SPLITTER
EXISTING EQUIPM
@ MINIPLANT
TEST FACILITY
AREA. (LOCATED
WEST WALL. NEW
ELECTRICAL/CONT
ROOM.)

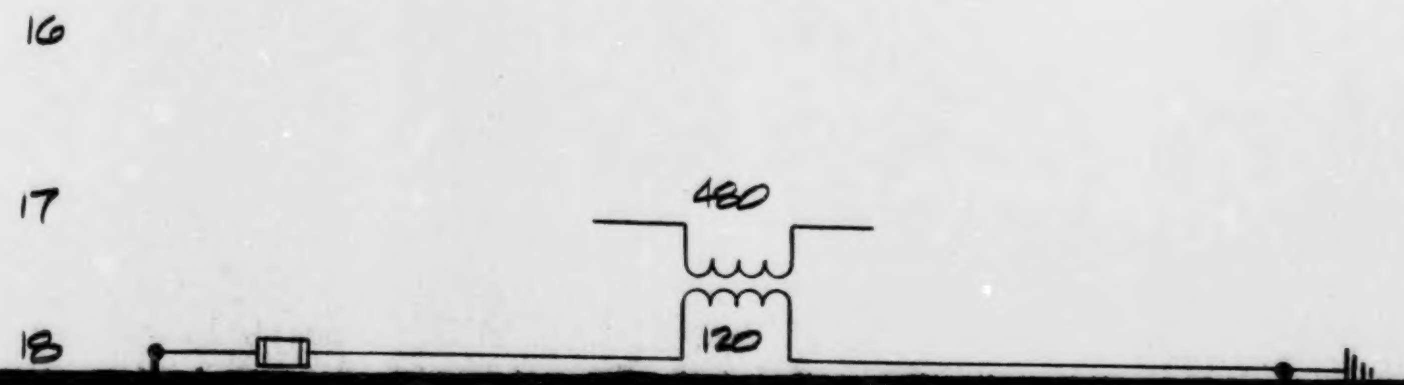
## SINGLE LINE DIAGRAMS


600A
600V
DISC. SW.
SPLITTER

EXISTING EQUIPMENT @ MINIPLANT TEST FACILITY AREA. (LOCATED ON WEST WALL - NEW ELECTRICAL/CONTROL ROOM.)

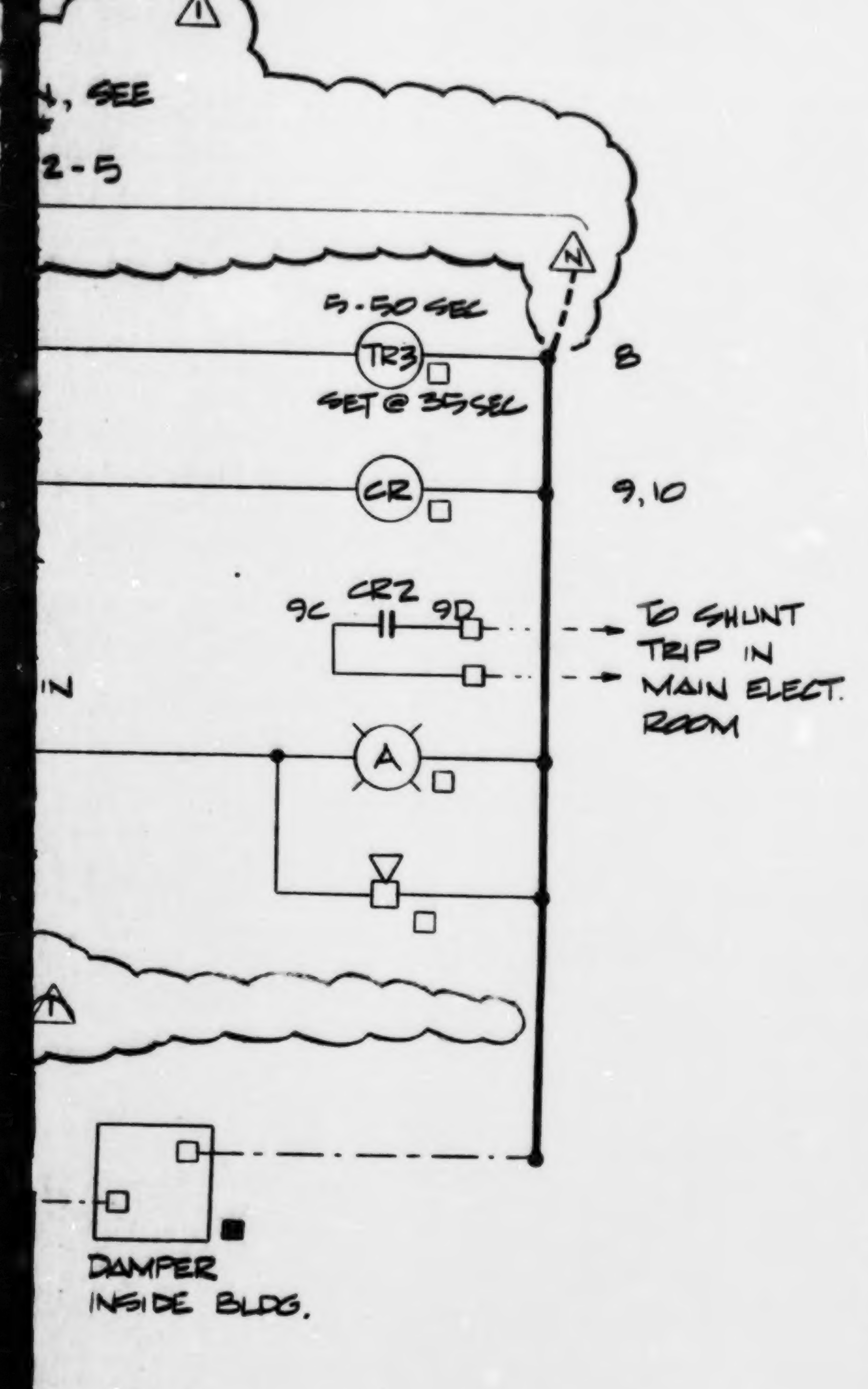

1
5
6
7
8
9
10
11
12
13
14
FOR CONTINUATION, SEE VENDOR PRINT # A149-15-SC-002-5
3
N
FLS
7A
5-50 SEC
TR3
SET @ 35 SEC
8
TR3-1
T.C.E.
CR
9,10
9A
9B
CONTACT OUTPUT ON HYDROCARBON LEAK IN ELECT ROOM.
9C
CR2
9D
TO SHUNT TRIP IN MAIN ELECT. ROOM
A
CR1
FOR CONT'N SEE V.P.# A149-15-SC-002-5
1
11
12
13A
13B
M2
(FROM EF#2)
DAMPER INSIDE BLDG.

## AIR MAKEUP UNIT V-1


15
16
17
18
480
120

IS SHOWN ON

2. DUE TO LOSS
INITIATING SH
BREAKER SUP
THE MINI PLANT
PRIOR TO CLO
THE OPERATING
PERSONNEL S
THE MINI PLANT
ROOM IS PRO
AND IT IS SAFE
POWER ON.



UNIT V-1

2. DUE TO LOSS OF POWER OR INITIATING SHUNT TRIP, THE MAIN BREAKER SUPPLYING POWER TO THE MINI PLANT WILL BE OPENED. PRIOR TO CLOSING THIS BREAKER, THE OPERATING / MAINTENANCE PERSONNEL SHALL ENSURE THAT THE MINI PLANT ELECTRICAL / CONTROL ROOM IS PROPERLY PRESSURIZED AND IT IS SAFE TO TURN THE POWER ON.

PROFESSIONAL ENGINEER ALBERTA
S. BASAPPA
87/10/21

PERMIT TO PRACTICE
KILBORN ENERGY INC.
Signature
Date OCT 4 87
PERMIT NUMBER: P 4386
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

KILBORN

PROJECT NO: A149-15

**NOTES:** DO NOT SCALE FROM DRAWINGS. REFER TO CEILING AND WINDOW MULLIONS IN RELATION TO PARTITIONS.

CONTRACTOR MUST VERIFY ALL DIMENSIONS; IN CASE OF ERRORS OR DISCREPANCIES ALBERTA PUBLIC WORKS, SUPPLY AND SERVICES MUST BE NOTIFIED.

| | | DATE: |
|---|---|---|
| DESIGNER | | |
| DRAWN BY | S. TURK | 21 OCT. 87 |
| DESIGN SUPERVISOR | S BASAPPA | 21. OCT 87 |
| PROJECT MANAGER | JE Hecck | 23 OCT 87 |

**REVISIONS**

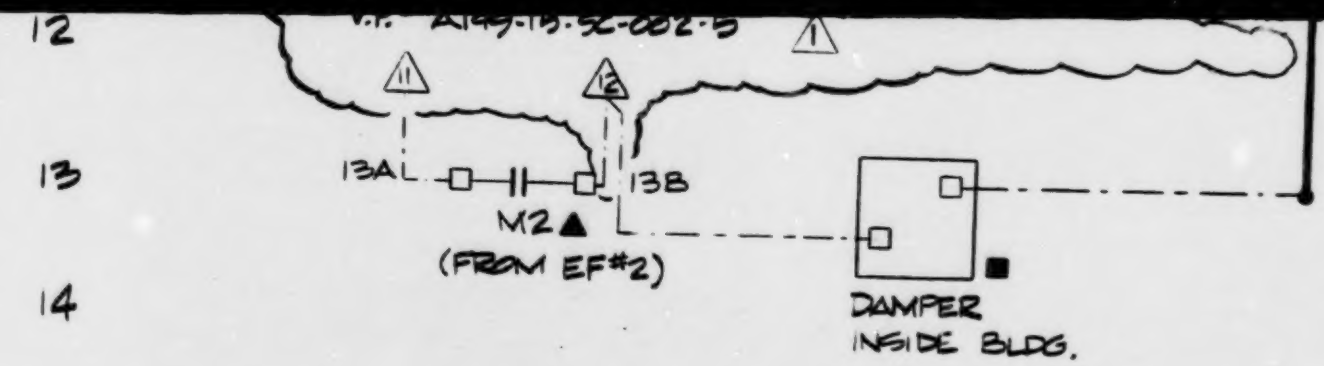
| NO. | DRAWN | APPROVE | | DATE: |
|---|---|---|---|---|
| 0 | ST | JEM | ISSUED FOR CONSTRUCTION | 21 OCT. 87 |
| 1 | ST | JEM | REVISED AIR MAKE-UP UNIT | 6 JAN. 88 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Alberta

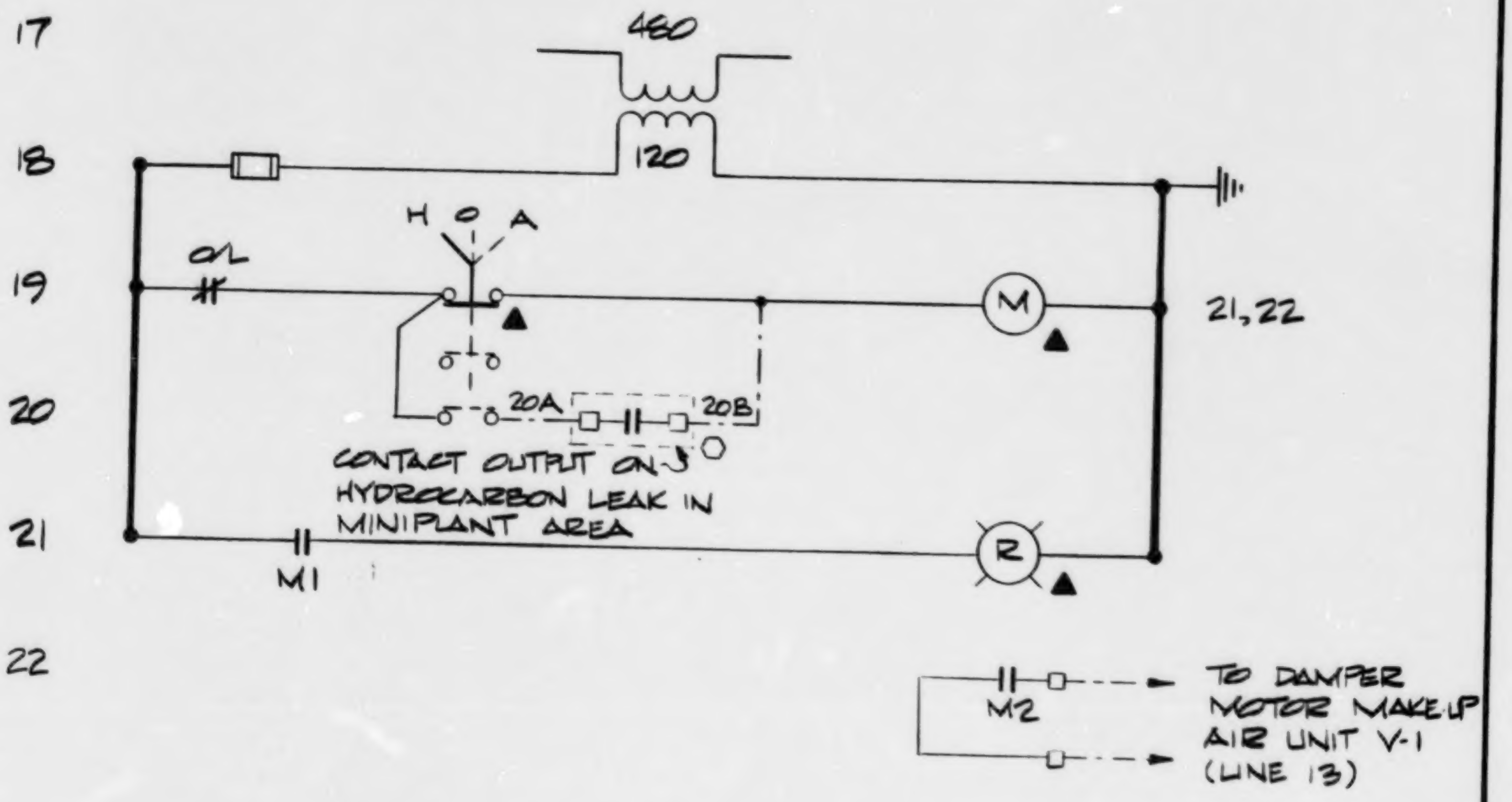
NORTH

DEVON COAL RESEARCH CENTER
FIELD RESEARCH
MAINTENANCE BUILDING

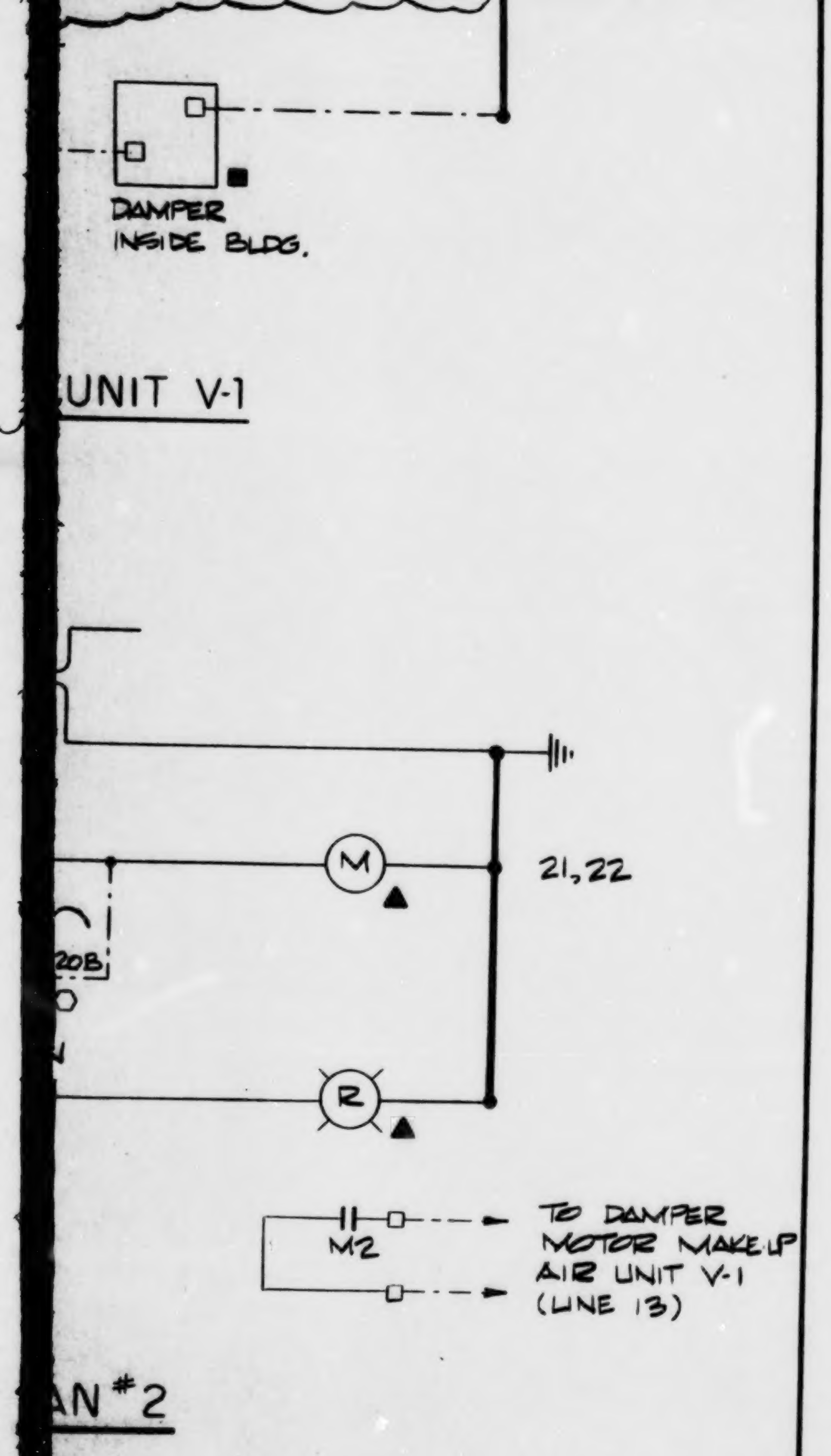
| NO. | DRAWN | APPROVE | | DATE: |
|---|---|---|---|---|


12
11
12
1
13
13A
13B
M2 ▲
(FROM EF#2)
■
DAMPER
INSIDE BLDG.
14

## AIR MAKEUP UNIT V-1


17
460
120
18
H O A
O/L
19
▲
M
▲
21,22
20
20A
20B
CONTACT OUTPUT ON-3
HYDROCARBON LEAK IN
MINIPLANT AREA
21
M1
R
▲
22
M2
TO DAMPER
MOTOR MAKE-UP
AIR UNIT V-1
(LINE 13)

## EXHAUST FAN #2


DAMPER
INSIDE BLDG.
UNIT V-1
M
21,22
20B
R
M2
TO DAMPER
MOTOR MAKE-UP
AIR UNIT V-1
(LINE 13)
AN #2

| NO. | DRAWN | APPROVE | | DATE: |
|---|---|---|---|---|
| 0 | ST | | ISSUED FOR CONSTRUCTION | 21 OCT, 87 |
| 1 | ST | | REVISED AIR MAKE-UP UNIT | 6 JAN, 88 |

**Alberta**

NORTH

DEVON COAL RESEARCH CENTER

FIELD RESEARCH
MAINTENANCE BUILDING

INDEX

- SITE PLAN & CONSTRUCTION SCHEDULE
- PRELIMINARY PLAN
- DEMOLITION PLAN
- PARTITION & DRAPERY PLAN
- FURNITURE PLAN
- ELECTRICAL & TELECOMMUNICATIONS PLAN
- SCREEN & PLANT PLAN
- REFLECTED CEILING PLAN
- SIGNAGE PLAN
- SPECIAL REQUIREMENTS PLAN
- DETAILS
- FINISH PLAN
- ELECTRICAL CONSULTANTS PLAN
- MECHANICAL CONSULTANTS PLAN

FLOOR: 1

DRAWING DESCRIPTION: SINGLE LINE & SCHEMATIC DIAGRAMS

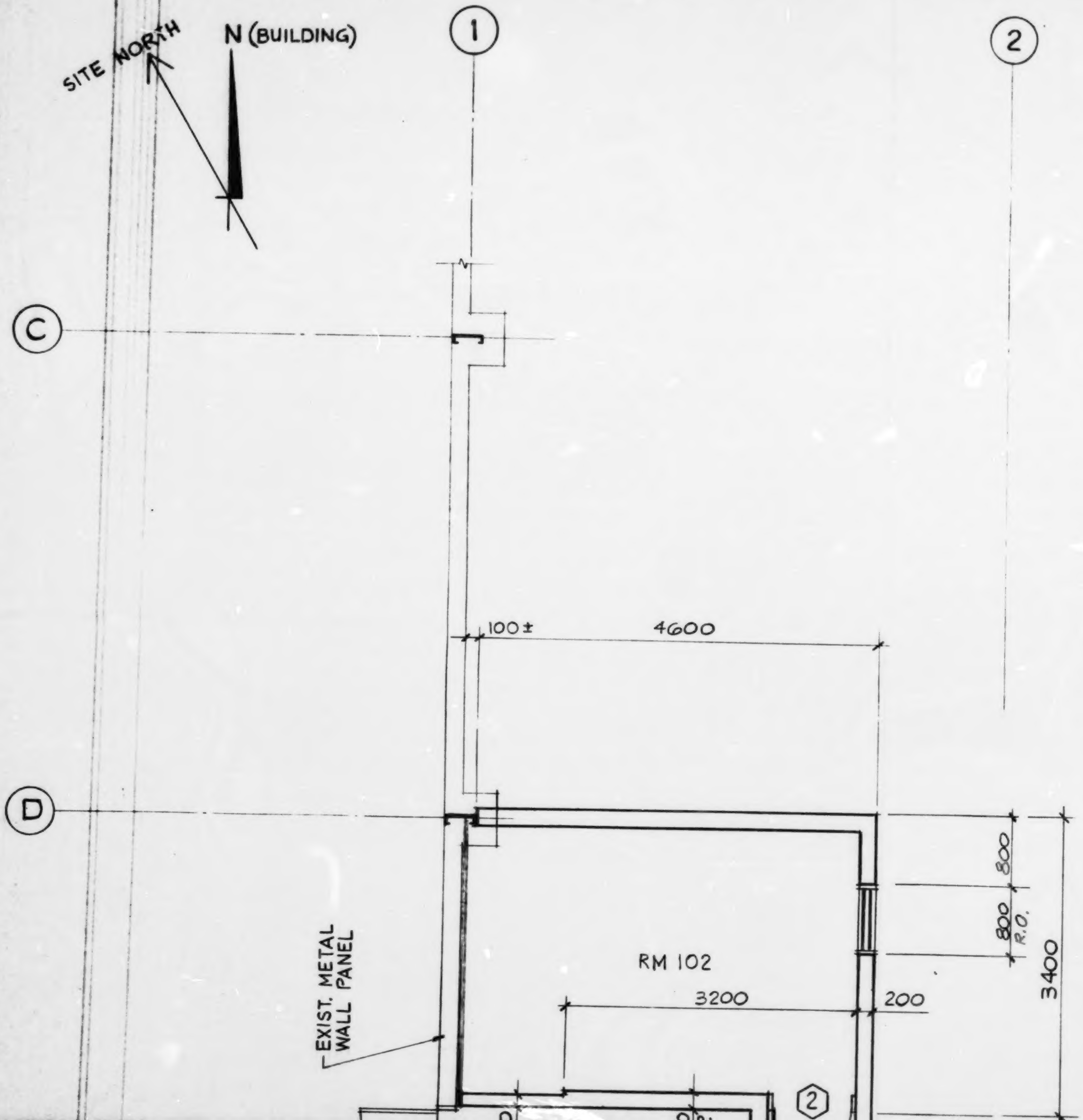
SCALE (METRIC): NTS

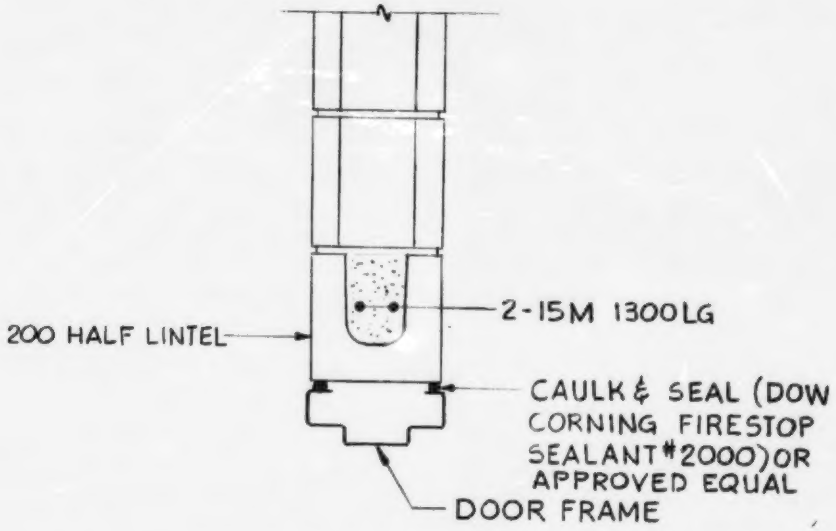
PROJECT NUMBER:

SHEET 2 OF 2

BUILDING NUMBER:

DRAWING NUMBER: 402


SITE NORTH
N (BUILDING)
1
2
C
D
100±
4600
800
800 R.O.
3400
RM 102
3200
200
EXIST. METAL WALL PANEL
2

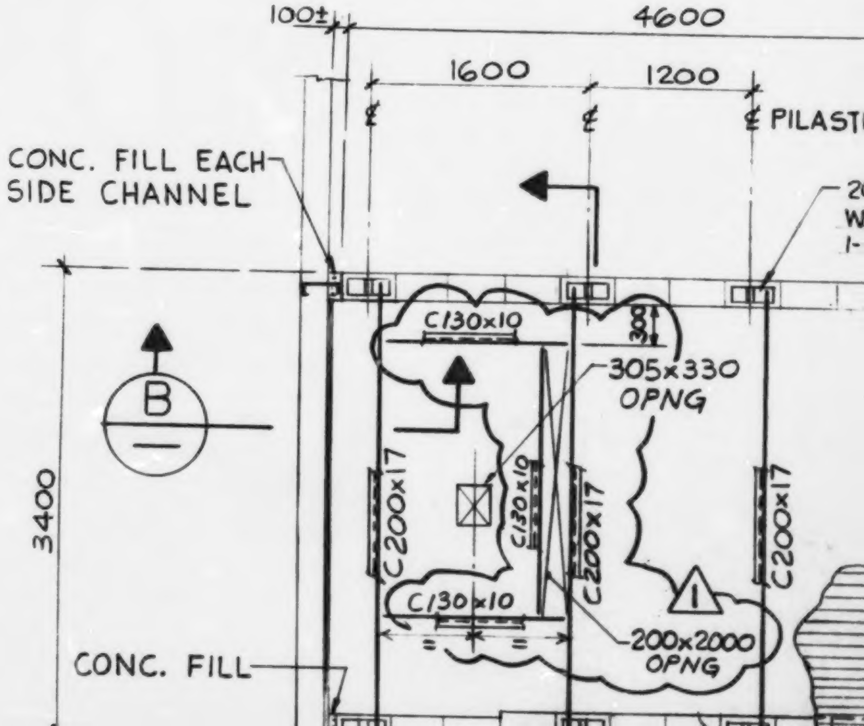

200 HALF LINTEL
2-15M 1300LG
CAULK & SEAL (DOW CORNING FIRESTOP SEALANT #2000) OR APPROVED EQUAL
DOOR FRAME

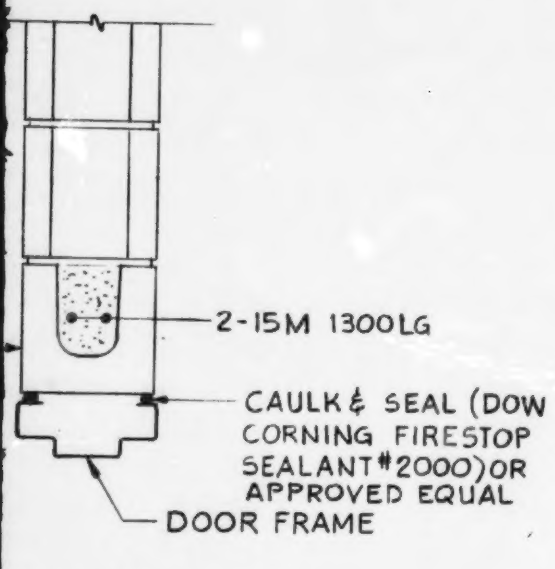
## DOOR HEADER DETAIL

1:10 (WINDOW FRAME SIMILAR)

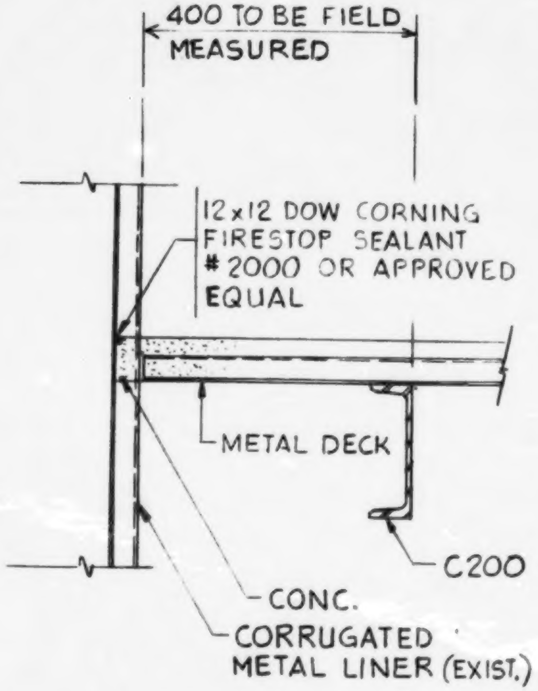
SE

1:10

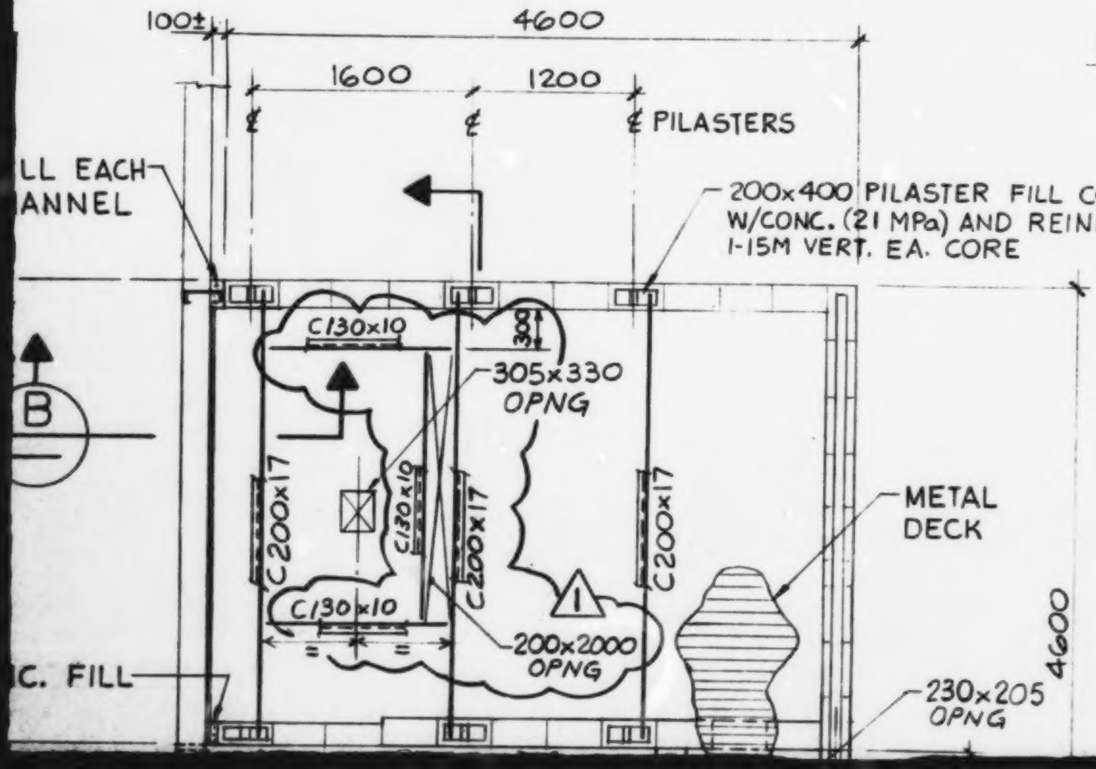

100±
4600
1600
1200
℄
℄
℄ PILAST
CONC. FILL EACH SIDE CHANNEL
B
C130x10
30
305x330 OPNG
3400
C200x17
C130x10
C200x17
C200x17
C130x10
1
200x2000 OPNG
CONC. FILL

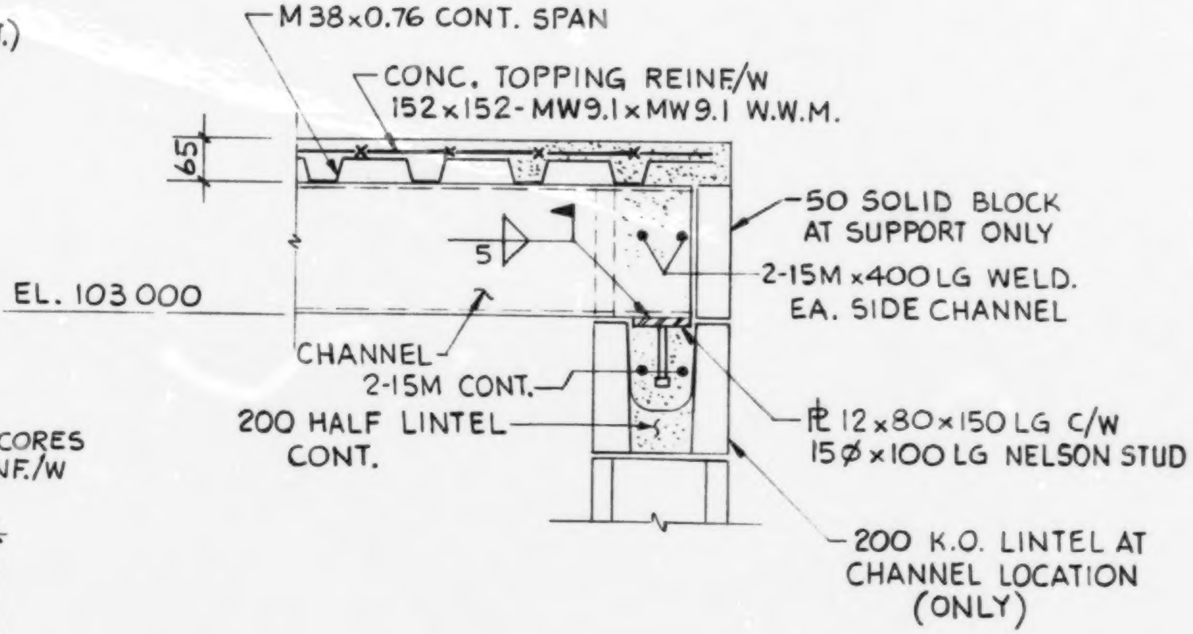

2-15M 1300LG
CAULK & SEAL (DOW CORNING FIRESTOP SEALANT #2000) OR APPROVED EQUAL
DOOR FRAME

## EADER DETAIL
(WINDOW FRAME SIMILAR)


400 TO BE FIELD MEASURED
12×12 DOW CORNING FIRESTOP SEALANT #2000 OR APPROVED EQUAL
METAL DECK
C200
CONC.
CORRUGATED METAL LINER (EXIST.)

## SECTION B
1:10


100±
4600
1600
1200
℄
℄
℄ PILASTERS
LL EACH ANNEL
200×400 PILASTER FILL CORES W/CONC. (21 MPa) AND REINF./W 1-15M VERT. EA. CORE
C130×10
80
30
305×330 OPNG
B
C200×17
C130×10
C200×17
C200×17
C130×10
1
200×2000 OPNG
METAL DECK
4600
C. FILL
230×205 OPNG


M38×0.76 CONT. SPAN
CONC. TOPPING REINF./W 152×152-MW9.1×MW9.1 W.W.M.
65
EL. 103 000
5
50 SOLID BLOCK AT SUPPORT ONLY
2-15M×400LG WELD. EA. SIDE CHANNEL
CHANNEL
2-15M CONT.
200 HALF LINTEL CONT.
℞ 12×80×150LG C/W 15∅×100LG NELSON STUD
200 K.O. LINTEL AT CHANNEL LOCATION (ONLY)

## DETAIL 1
1:10

65 THK CONC. TOPPING ON GALV. METAL DECK
T.O.S EL. 103 200

**GENERAL NOTES**

1. Structural steel a shall conform to edition) - Grade 300

2. Metal decking sh specified and shall Grade "A" coated wi

3. Concrete Materials Construction sh CAN3-A23.1-M77.

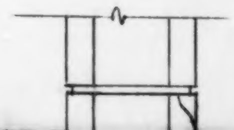
4. Concrete shall hav strength of 21 mPa be type 10. Normal

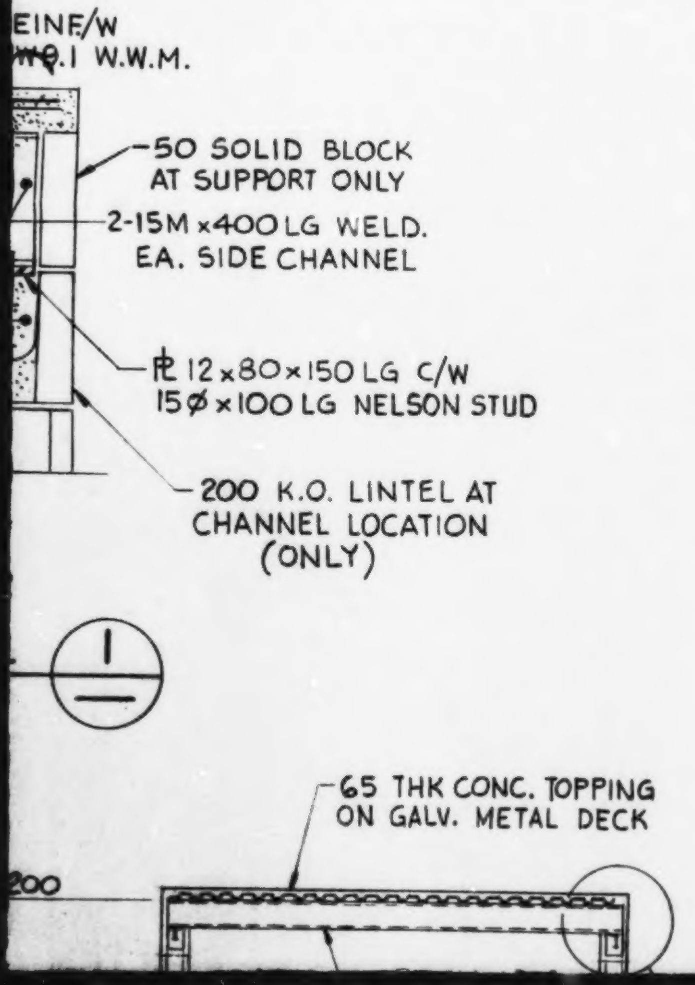
5. Reinforcing steel G30.16-M77 High St Steel Deformed Bars

   Welded steel Wire Reinforcement sha G30.5-M1983.

6. Concrete block wall Hollow Masonry Uni CAN3-A165, applic load-bearing and n units. Walls sh accordance with Construction for Bu

7. Where indicated, do shall have a 1 hour labelled in a specifications and U

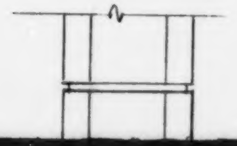



EINF/W
W9.1 W.W.M.
50 SOLID BLOCK AT SUPPORT ONLY
2-15M ×400 LG WELD. EA. SIDE CHANNEL
℄ 12×80×150 LG C/W 15Ø×100 LG NELSON STUD
200 K.O. LINTEL AT CHANNEL LOCATION (ONLY)
1
65 THK CONC. TOPPING ON GALV. METAL DECK
200

## GENERAL NOTES

1. Structural steel and miscellaneous metals shall conform to CSA G40.21- (latest edition) - Grade 300W.
2. Metal decking shall be as shown and specified and shall conform to ASTM A446-76 Grade "A" coated with Z275 zinc coating.
3. Concrete Materials and Methods of Concrete Construction shall conform to CAN3-A23.1-M77.
4. Concrete shall have a minimum compressive strength of 21 mPa at 28 days. Cement shall be type 10. Normal Portland cement.
5. Reinforcing steel shall conform to CSA G30.16-M77 High Strength Low Alloy Billet Steel Deformed Bars and shall be grade 400.

   Welded steel Wire Fabric for Concrete Reinforcement shall conform to CSA G30.5-M1983.
6. Concrete block walls shall be of high weight Hollow Masonry Units and shall conform to CAN3-A165, applicable standards for load-bearing and non-load bearing masonry units. Walls shall be constructed in accordance with CSA A371-M1980 Masonry Construction for Buildings.
7. Where indicated, doors, frames and windows, shall have a 1 hour fire rating and shall be labelled in accordance with the specifications and ULC requirements.



**Alberta**

**PUBLIC WORKS,
SUPPLY AND SERVICES
Property Planning Division**

A.P.W.S.S. USE ONLY

PERMIT TO PRACTICE
KILBORN ENERGY INC.
Signature
Date 26 OCT 1987
PERMIT NUMBER: P 438[illegible]
The Association of Professional Engineers,
Geologists and Geophysicists of [illegible]

**KILBORN**

PROJECT NO. A149-15

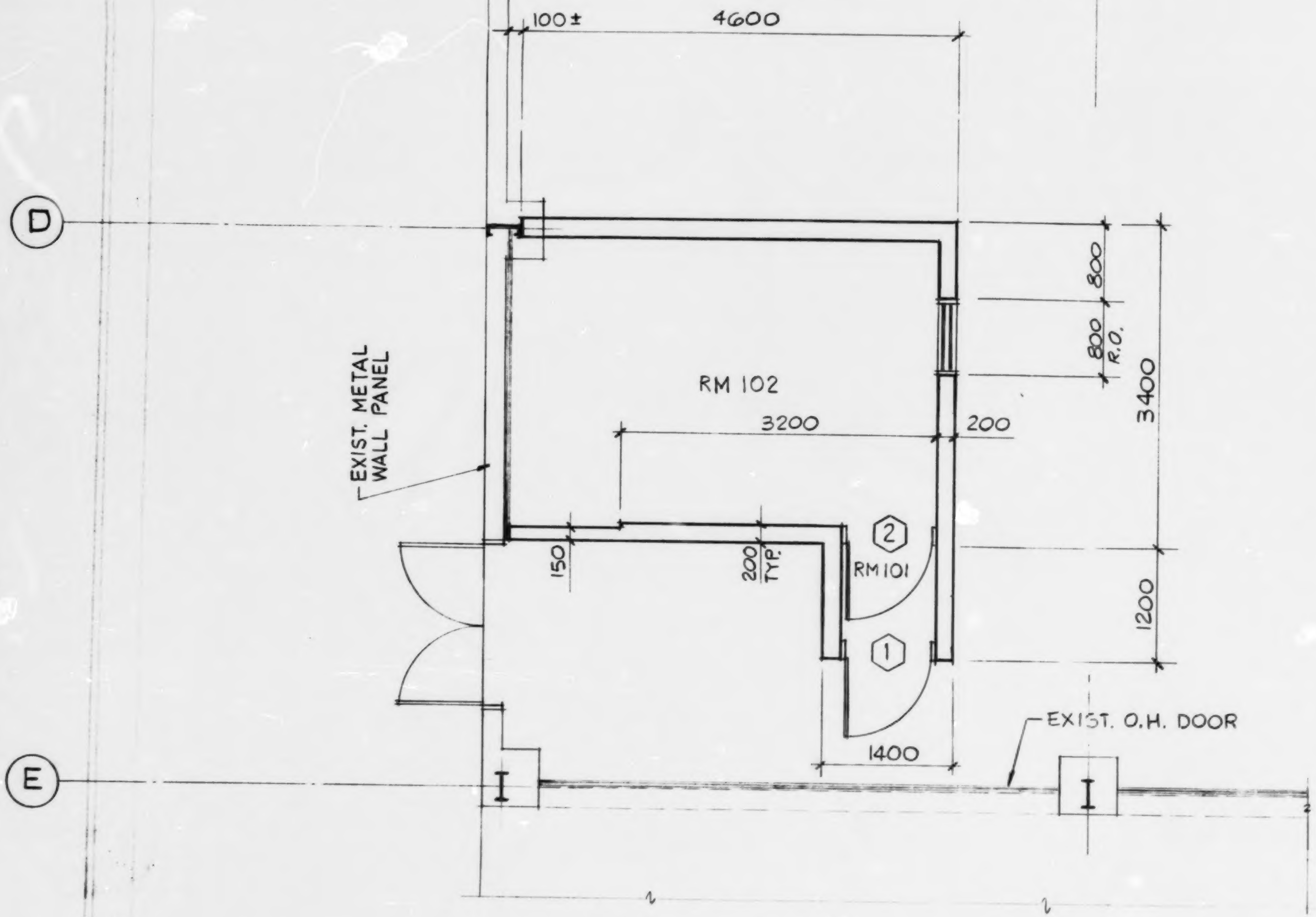
NOTES: DO NOT SCALE FROM DRAWINGS. REFER TO CEILING AND WINDOW MULLIONS IN RELATION TO PARTITIONS.

CONTRACTOR MUST VERIFY ALL DIMENSIONS; IN CASE OF ERRORS OR DISCREPANCIES ALBERTA PUBLIC WORKS, SUPPLY AND SERVICES MUST BE NOTIFIED.

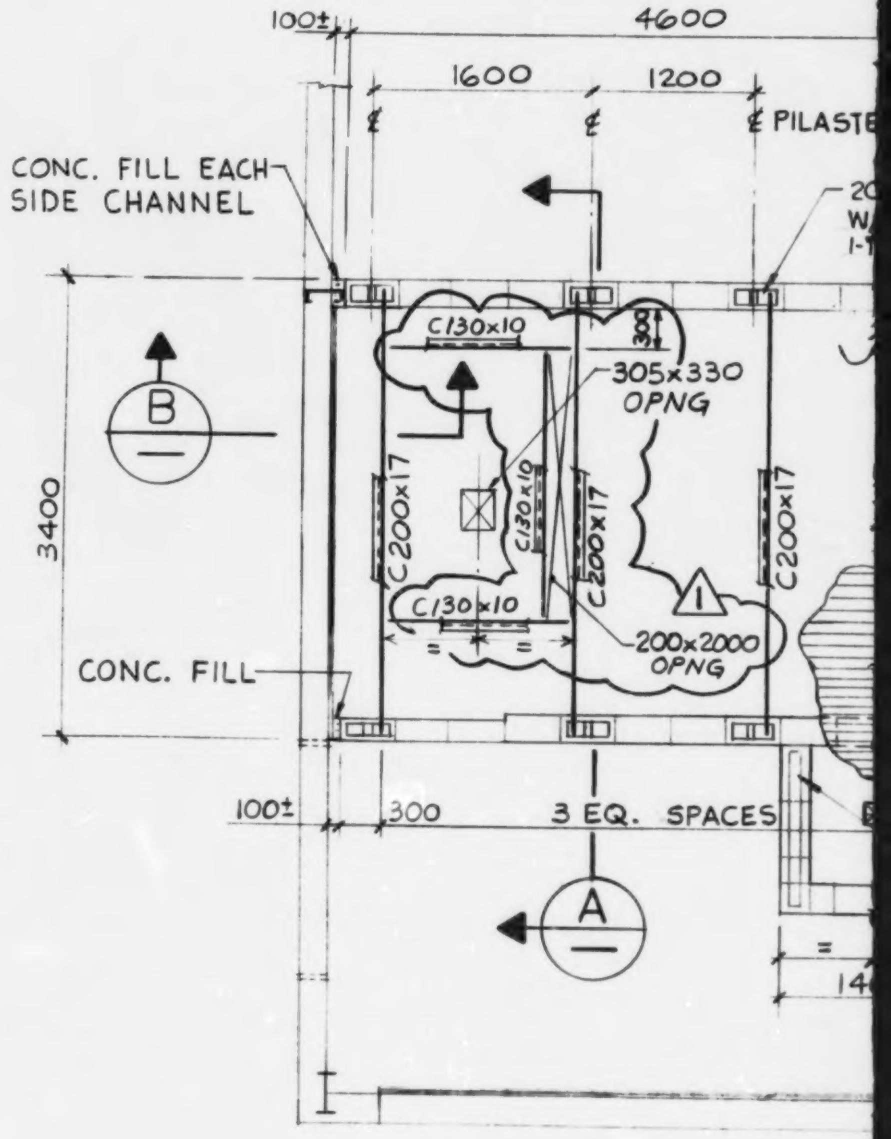
| | | |
|---|---|---|
| DESIGNER | C. LYTSAKIS | DATE: |

DOOR HEADER DETAIL
1:10 (WINDOW FRAME SIMILAR)

SE
1:10


100±
4600
D
E
EXIST. METAL WALL PANEL
RM 102
3200
200
800
800 R.O.
3400
1200
150
200 TYP.
2
RM 101
1
1400
EXIST. O.H. DOOR

## FLOOR PLAN
1:50


100±
4600
1600
1200
℄
℄
℄ PILASTE
CONC. FILL EACH SIDE CHANNEL
B
3400
C130x10
305x330 OPNG
C200x17
C130x10
C200x17
C200x17
C130x10
1
200x2000 OPNG
CONC. FILL
100±
300
3 EQ. SPACES
A
=
14

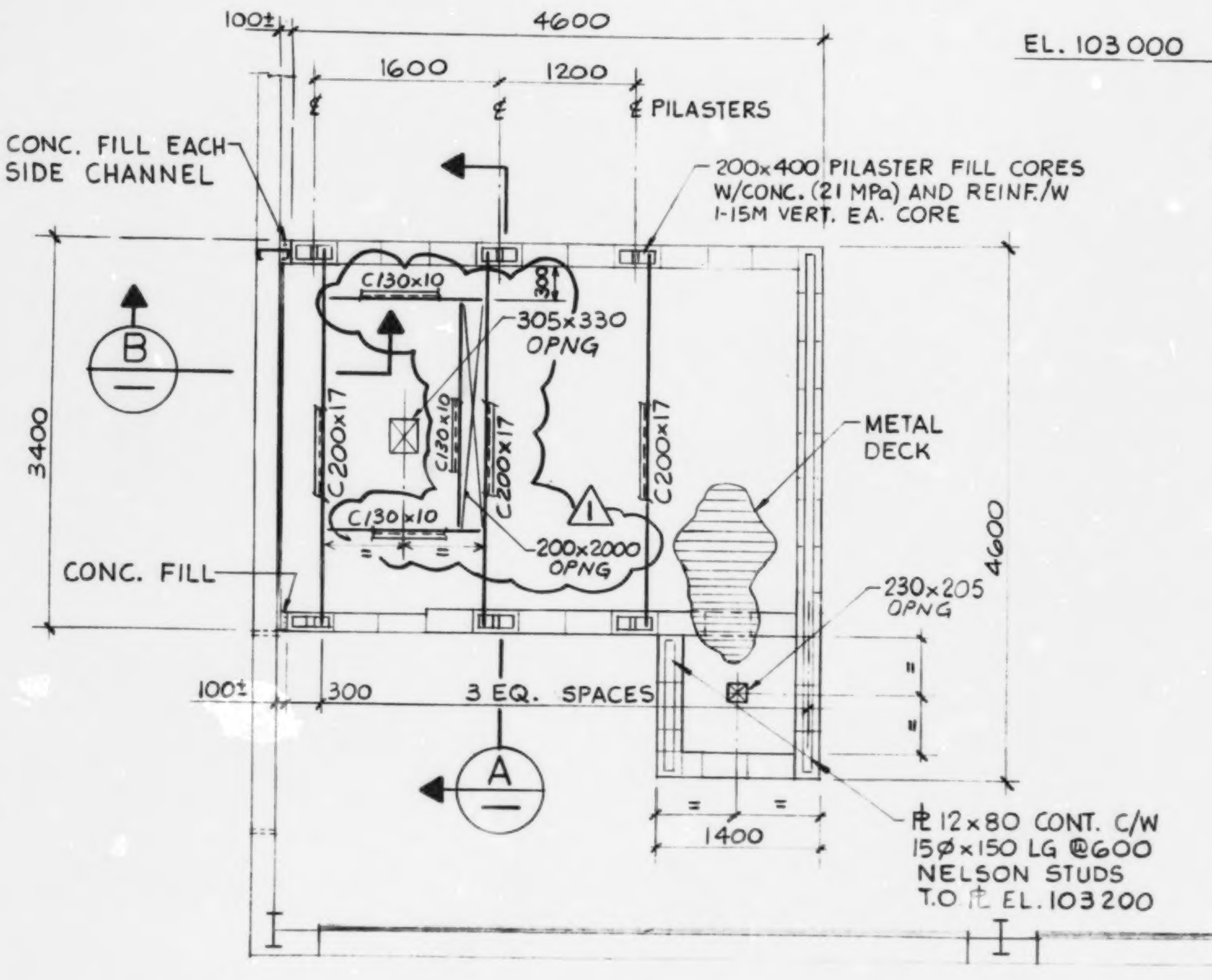
## ROOF PLAN
1:50

1:10 (WINDOW FRAME SIMILAR)

1:10

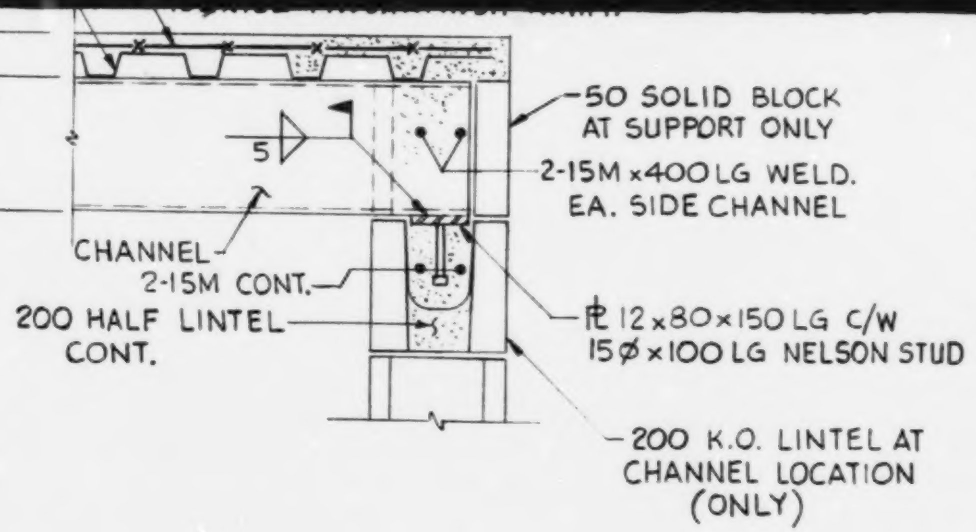
load-bea
units.
accordan
Construc

7. Where in
shall hav
labelled
specifica


100±
4600
1600
1200
℄
℄
℄ PILASTERS
CONC. FILL EACH SIDE CHANNEL
200×400 PILASTER FILL CORES W/CONC. (21 MPa) AND REINF./W 1-15M VERT. EA. CORE
B
3400
C130×10
305×330 OPNG
C200×17
C130×10
C200×17
C200×17
C130×10
1
METAL DECK
200×2000 OPNG
CONC. FILL
230×205 OPNG
4600
100±
300
3 EQ. SPACES
A
℄ 12×80 CONT. C/W 15Ø×150 LG @600 NELSON STUDS T.O ℄ EL. 103200
1400

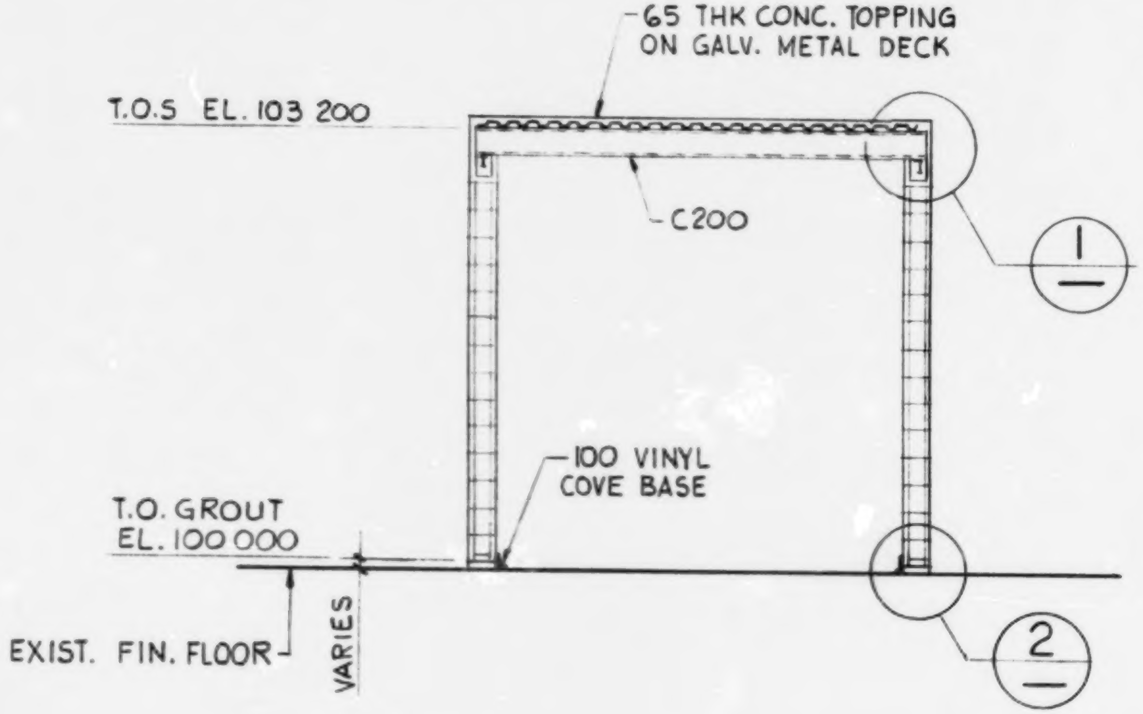
## ROOF PLAN

1:50


65
EL. 103 000
5
50 SOLID BLOCK AT SUPPORT ONLY
2-15M ×400 LG WELD. EA. SIDE CHANNEL
CHANNEL
2-15M CONT.
200 HALF LINTEL CONT.
℄ 12×80×150 LG C/W 15Ø×100 LG NELSON STUD
200 K.O. LINTEL AT CHANNEL LOCATION (ONLY)

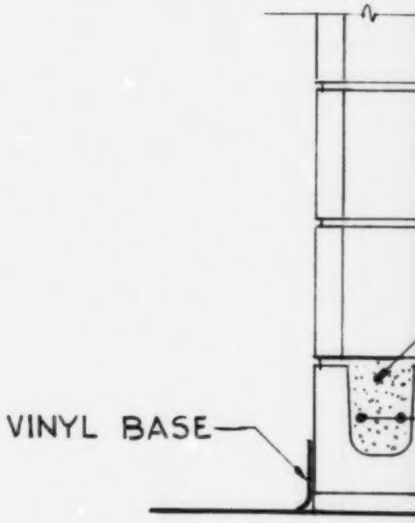
## DETAIL 1

1:10


65 THK CONC. TOPPING ON GALV. METAL DECK
T.O.S EL. 103 200
C200
1
100 VINYL COVE BASE
T.O. GROUT EL. 100 000
EXIST. FIN. FLOOR
VARIES
2

## SECTION A

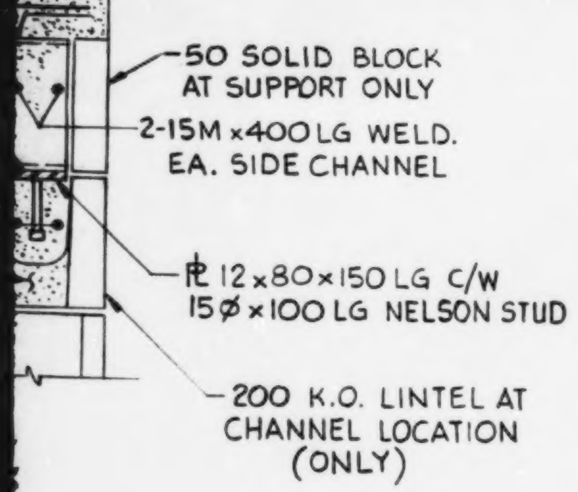
1:50



DETA

1:10

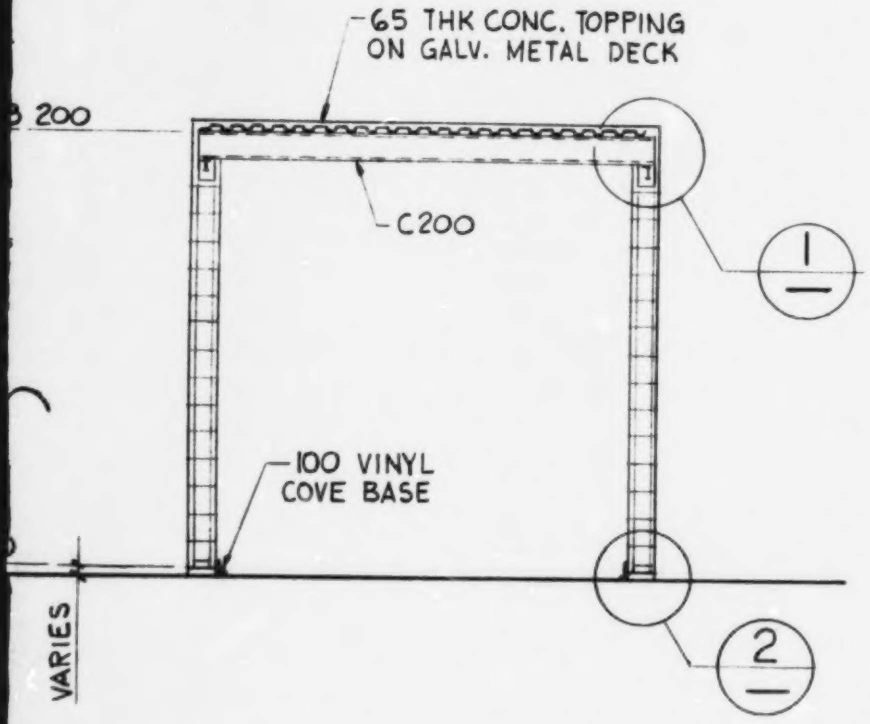
D
1
STEEL COL


50 SOLID BLOCK AT SUPPORT ONLY
2-15M × 400 LG WELD. EA. SIDE CHANNEL
℄ 12 × 80 × 150 LG C/W 15∅ × 100 LG NELSON STUD
200 K.O. LINTEL AT CHANNEL LOCATION (ONLY)

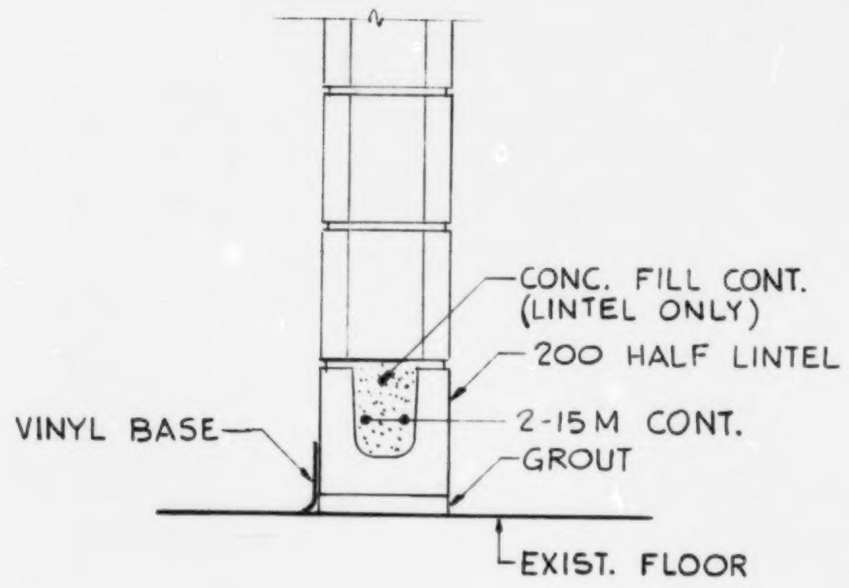
L 1

load-bearing and non-load bearing masonry units. Walls shall be constructed in accordance with CSA A371-M1980 Masonry Construction for Buildings.

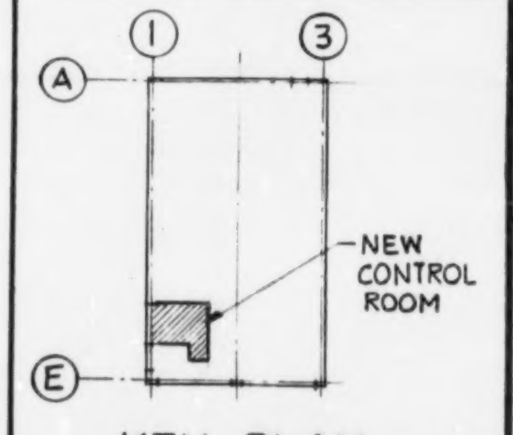
7. Where indicated, doors, frames and windows, shall have a 1 hour fire rating and shall be labelled in accordance with the specifications and ULC requirements.


65 THK CONC. TOPPING ON GALV. METAL DECK
200
C200
1
100 VINYL COVE BASE
VARIES
2

SECTION A
1:50


CONC. FILL CONT. (LINTEL ONLY)
200 HALF LINTEL
2-15M CONT.
GROUT
VINYL BASE
EXIST. FLOOR

DETAIL 2
1:10


1
3
A
E
NEW CONTROL ROOM

KEY PLAN

M. C. BANKS

**PERMIT TO PRACTICE**
KILBORN ENERGY INC.
Signature
Date 26 OCT 1987
PERMIT NUMBER: P 43[illegible]
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

# KILBORN

PROJECT NO. A149-15

NOTES: DO NOT SCALE FROM DRAWINGS. REFER TO CEILING AND WINDOW MULLIONS IN RELATION TO PARTITIONS.

CONTRACTOR MUST VERIFY ALL DIMENSIONS; IN CASE OF ERRORS OR DISCREPANCIES ALBERTA PUBLIC WORKS, SUPPLY AND SERVICES MUST BE NOTIFIED.

| | | |
|---|---|---|
| DESIGNER | C. LYTSAKIS | DATE: |
| DRAWN BY | C. LYTSAKIS | 10/23/87 |
| DESIGN SUPERVISOR | M BANKS | 10/23/87 |
| PROJECT MANAGER | JE Hauck | 10/23/87 |

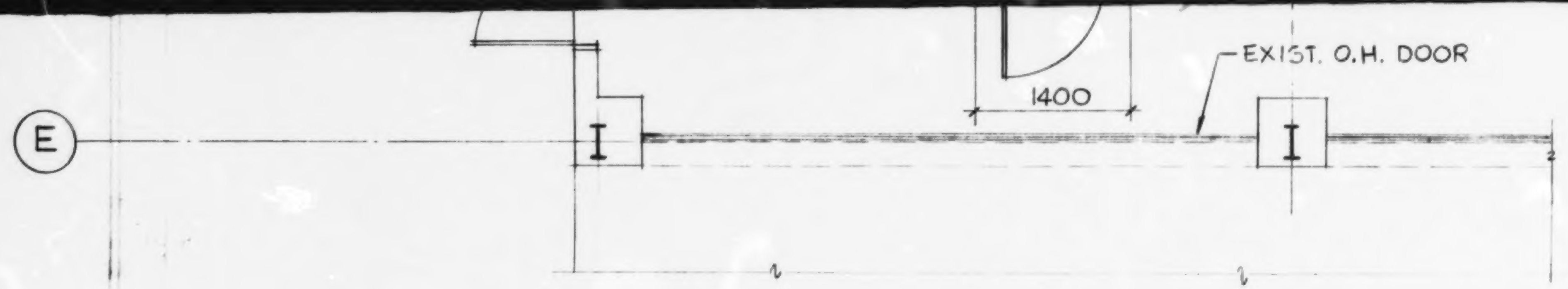
**REVISIONS**

| NO. | DRAWN | APPROVE | | DATE: |
|---|---|---|---|---|
| 0 | C.L. | JEH | ISSUED FOR CONSTRUCTION | 10/23/87 |
| 1 | C.L. | JEH | ROOF CABLE OPNG REV'D | 12/23/87 |

Alberta

NORTH
SITE NORTH
N

DEVON COAL RESEARCH CENTRE
FIELD RESEARCH
MAINTENANCE BUILDING

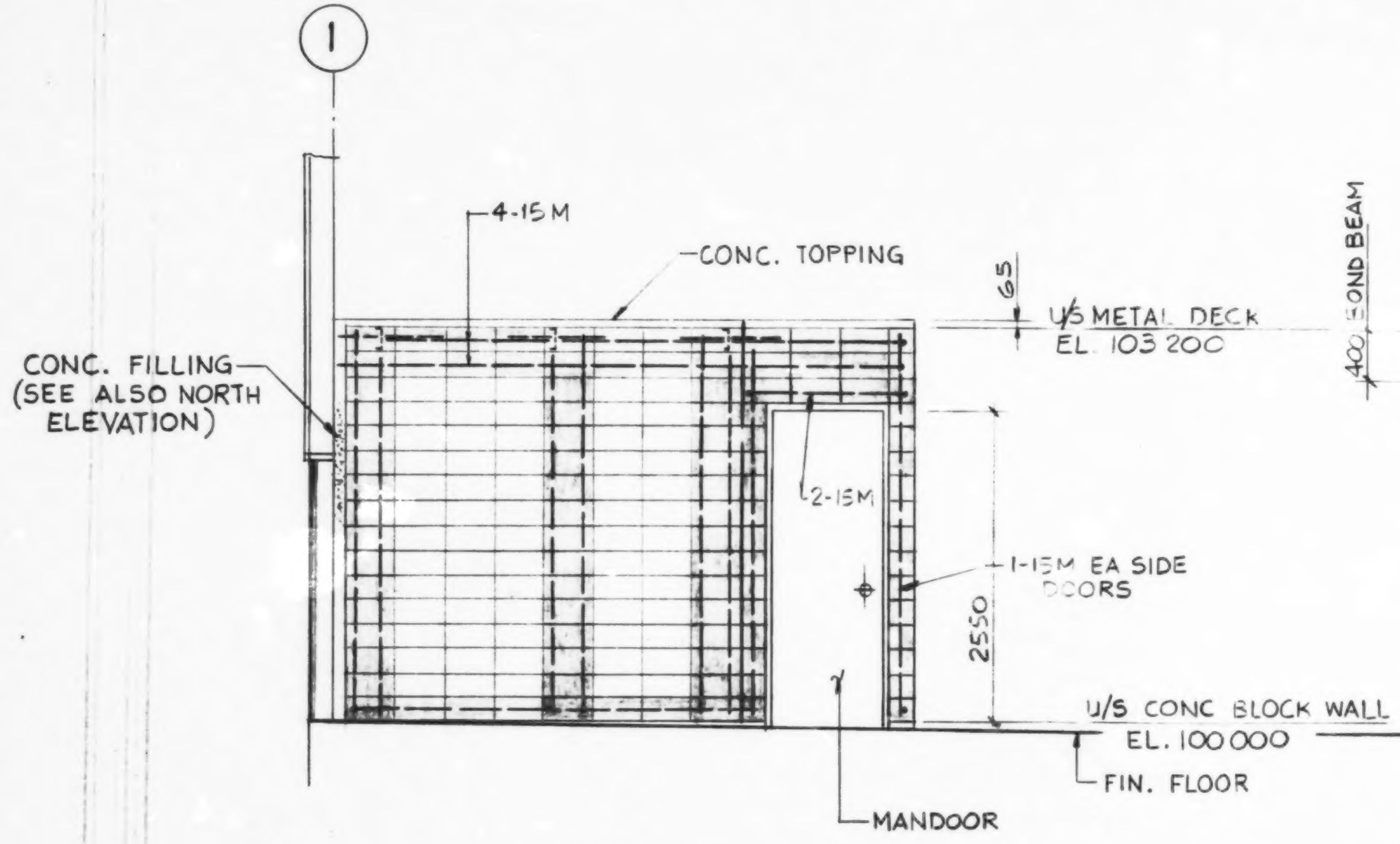

EXIST. O.H. DOOR
1400
E

FLOOR PLAN

1:50

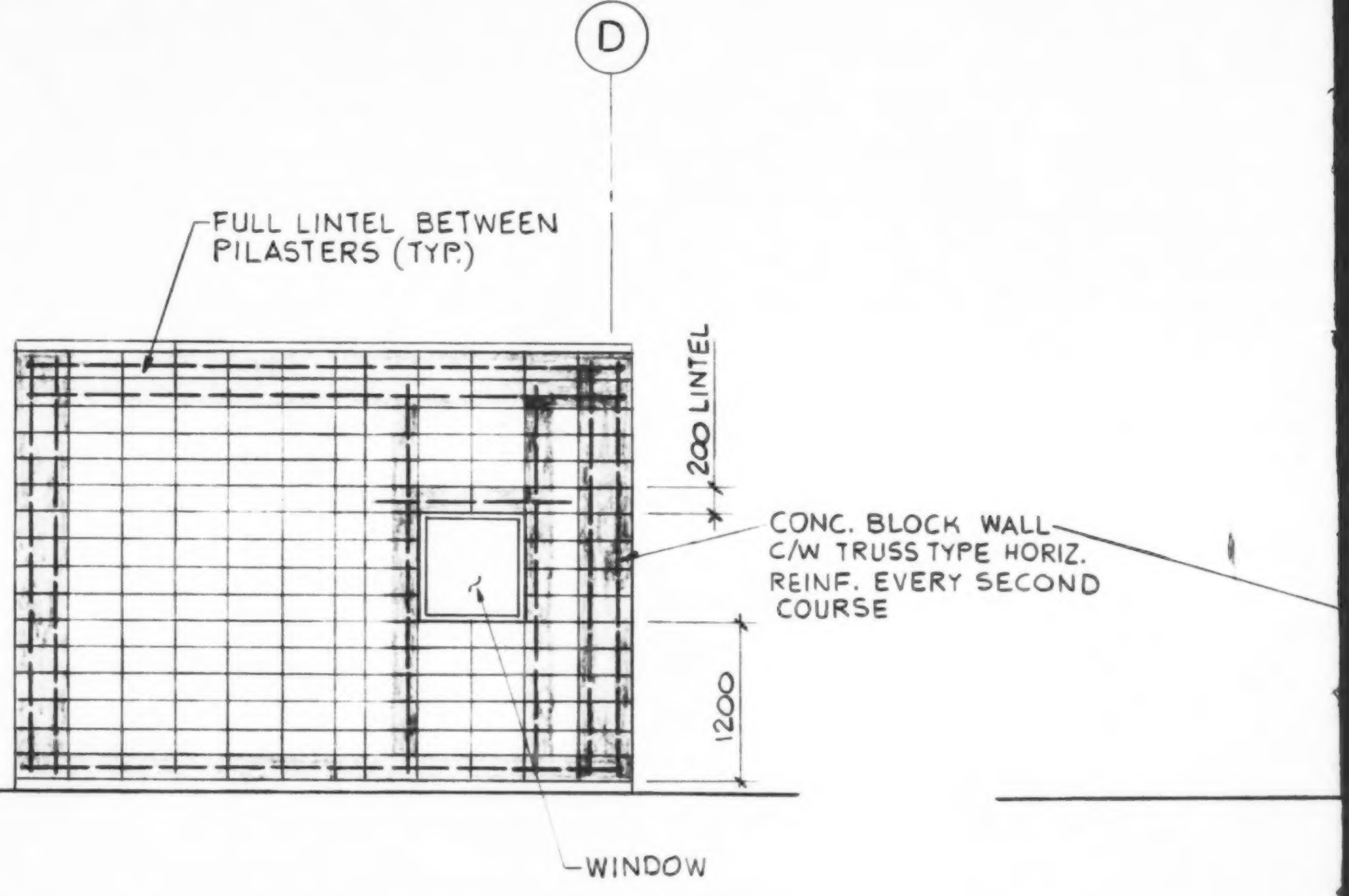
ROOF PLAN

1:50


1
4-15M
CONC. TOPPING
CONC. FILLING (SEE ALSO NORTH ELEVATION)
65
U/S METAL DECK
EL. 103 200
400 BOND BEAM
2-15M
1-15M EA SIDE DOORS
2550
U/S CONC BLOCK WALL
EL. 100 000
FIN. FLOOR
MANDOOR

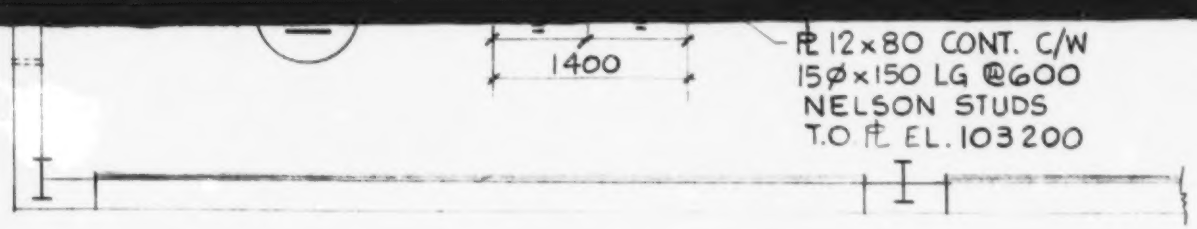
SOUTH ELEVATION

1:50


D
FULL LINTEL BETWEEN PILASTERS (TYP.)
200 LINTEL
CONC. BLOCK WALL C/W TRUSS TYPE HORIZ. REINF. EVERY SECOND COURSE
1200
WINDOW

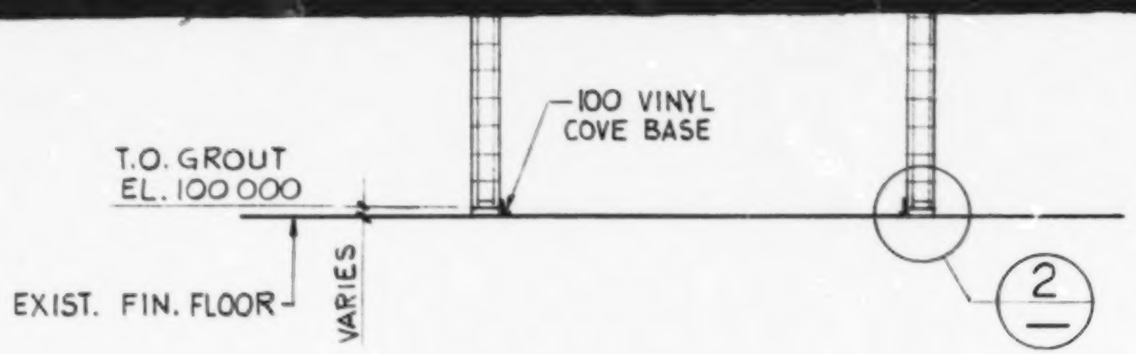
EAST ELEVATION

1:50


1400
PL 12×80 CONT. C/W
150×150 LG @600
NELSON STUDS
T.O PL EL. 103200

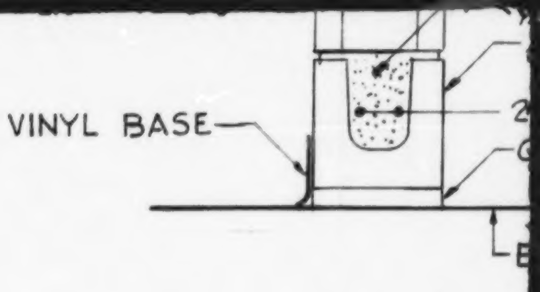
## ROOF PLAN

1:50


T.O. GROUT
EL. 100 000
100 VINYL
COVE BASE
EXIST. FIN. FLOOR
VARIES
2

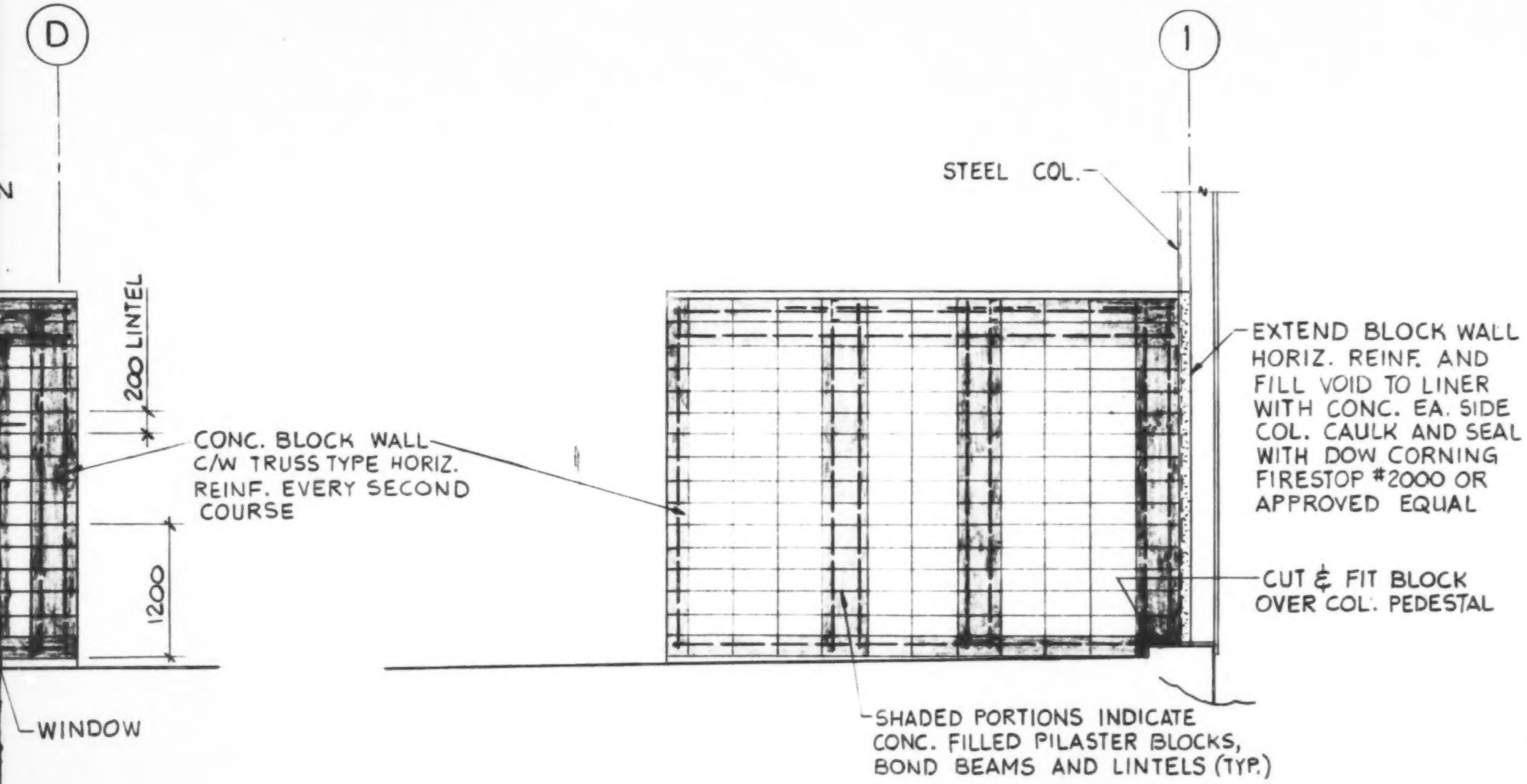
## SECTION A

1:50



## DETAIL

1:10


D
1
STEEL COL.
200 LINTEL
1200
WINDOW

CONC. BLOCK WALL C/W TRUSS TYPE HORIZ. REINF. EVERY SECOND COURSE

EXTEND BLOCK WALL HORIZ. REINF. AND FILL VOID TO LINER WITH CONC. EA. SIDE COL. CAULK AND SEAL WITH DOW CORNING FIRESTOP #2000 OR APPROVED EQUAL

CUT & FIT BLOCK OVER COL. PEDESTAL

SHADED PORTIONS INDICATE CONC. FILLED PILASTER BLOCKS, BOND BEAMS AND LINTELS (TYP.)

## NORTH ELEVATION

1:50

## DOOR SCHEDULE

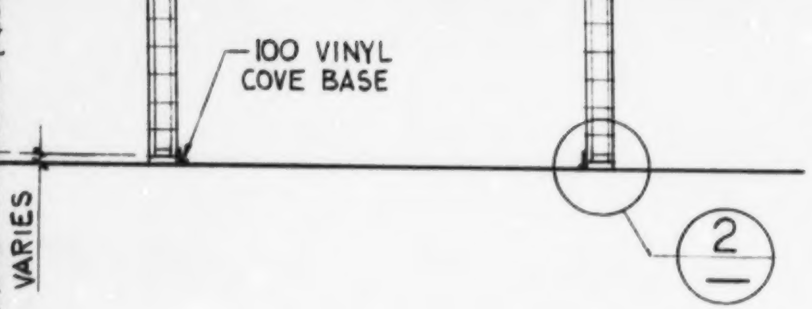
TYPE A

NOTES:
1) DOOR ① RATED
2) DOOR HEIGHT

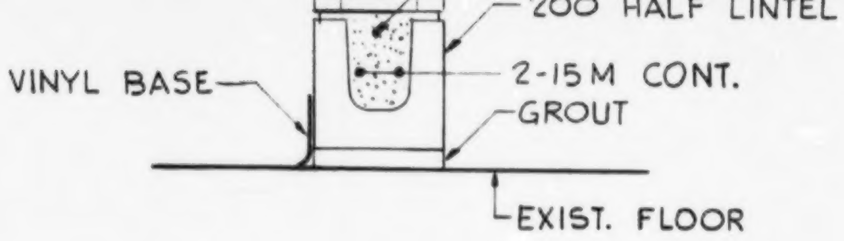
| DOOR | | | | | FRAME | | HARDWARE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⬡ MARK | SIZE TH.×W.×H. | TYPE | CONSTRUCTION | SWING | PRESSED METAL | INSULATION | (PAIRS) BUTT HINGES | LOCKS | CLOSER | STOP | HOLDER | PANIC | WEATHER STRIPPING | H.M. = H<br>L.H.R.B. |
| 1 | 45×900×2550 | A | H.M. | L.H.R.B | ● | | 1½ | ● | ● | ● | ● | ● | ● | DOORS |
| 2 | 45×900×2550 | A | H.M. | | ● | | 1½ | ● | ● | ● | ● | ● | ● | SHOP PR |
| | | | | | | | | | | | | | | |

## ROOM FINISH

| ROOM | FLOOR | CEILING | WALLS |
|---|---|---|---|
| 101<br>102 | PAINTED WITH CONC. CURING AND SEALING COMPOUND, BATTLESHIP GRAY | METAL DECK GALV. STEEL WORK PAINTED TO MATCH EXISTING | CONC. BLOCK-PAINT FINISH WITH BLOCK FILL PRIMER-VINYL COVE BASE. WALL PAINT TO BE BONE WHITE |



SECTION A
1:50



DETAIL 2
1:10

|  |  |  |  |  |
|---|---|---|---|---|
| 0 | C.L. |  | ISSUED FOR CONSTRUCTION | 10/23/87 |
| 1 | C.L. | JEH | ROOF CABLE OPNG REV'D | 12/23/87 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
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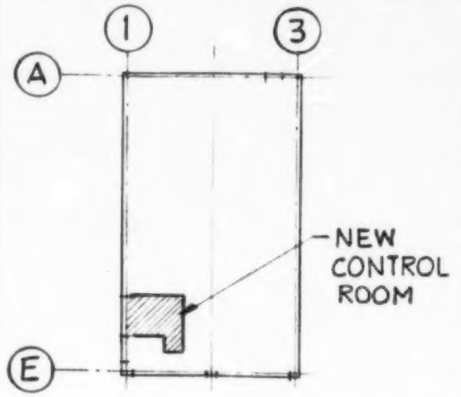
Alberta



KEY PLAN

NORTH

SITE NORTH
N

DEVON COAL RESEARCH CENTRE

FIELD RESEARCH
MAINTENANCE BUILDING

INDEX

- ☒ SITE PLAN & CONSTRUCTION SCHEDULE
- ☐ PRELIMINARY PLAN
- ☐ DEMOLITION PLAN
- ☒ PARTITION & DRAPERY PLAN
- ☐ FURNITURE PLAN
- ☐ ELECTRICAL & TELECOMMUNICATIONS PLAN
- ☐ SCREEN & PLANT PLAN
- ☐ REFLECTED CEILING PLAN
- ☐ SIGNAGE PLAN
- ☐ SPECIAL REQUIREMENTS PLAN
- ☐ DETAILS
- ☒ FINISH PLAN
- ☐ ELECTRICAL CONSULTANTS PLAN
- ☐ MECHANICAL CONSULTANTS PLAN

FLOOR
1

DRAWING DESCRIPTION
CONTROL ROOM
PLANS, ELEVAT.,
SECTIONS AND DETAILS

SCALE (METRIC)
AS NOTED

PROJECT NUMBER

SHEET 1 OF 1

BUILDING NUMBER

DRAWING NUMBER
101, 901

## DOOR SCHEDULE

TYPE A

NOTES:
1) DOOR ① TO BE 1 HOUR FIRE-RATED
2) DOOR HEIGHT TO BE FIELD VERIFIED

| DOOR |  |  |  |  | FRAME |  | HARDWARE |  |  |  |  |  |  | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⬡ MARK | SIZE TH. × W. × H. | TYPE | CONSTRUCTION | SWING | PRESSED METAL | INSULATION | (PAIRS) BUTT HINGES | LOCKS | CLOSER | STOP | HOLDER | PANIC | WEATHER STRIPPING | H.M. = HOLLOW METAL<br>L.H.R.B. = LEFT HAND REVERSE BEVEL |
| 1 | 45 × 900 × 2550 | A | H.M. | L.H.R.B. | ● |  | 1½ | ● | ● | ● | ● | ● | ● | DOORS AND FRAMES TO BE |
| 2 | 45 × 900 × 2550 | A | H.M. |  | ● |  | 1½ | ● | ● | ● | ● | ● | ● | SHOP PRIMED AND SITE PAINTED |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## ROOM FINISH

| ROOM | FLOOR | CEILING | WALLS | WINDOW |
|---|---|---|---|---|
| 101 | PAINTED WITH CONC. CURING AND SEALING COMPOUND, BATTLESHIP GRAY | METAL DECK GALV. STEEL WORK PAINTED TO MATCH EXISTING | CONC. BLOCK-PAINT FINISH WITH BLOCK FILL PRIMER-VINYL COVE BASE. WALL | 800 × 800 DOUBLE GLAZED GEORGIAN WIRED GLASS 1 hr FIRERATED, PRESS. METAL FRAME |
| 102 |  |  |  |  |
|  |  |  | PAINT TO BE BONE WHITE |  |